RECORD OF CHANGES TO DOCUMENT

PHO-1Z4000, Vol I, Rev 1

ISSUED 24 JUNE 1964

Page Sequence of Vol I, Rev 1 Material in Vol IA	
Section 4 (Para. 4.4 only)	4-223 through 4-239
Section 5	5-1 through 5-6

Change 1 — 22 January 1965

FRONT MATTER

Add the Title Page and Pages -ii- through -v-.

SECTION 4

Add Pages 4-240 through 4-313.

Section 4 now contains Pages 4-1 through 4-313.

N85-72942

(NASA-CR-175866) GCSS TELEMETRY NETWORK DATA BOOK, VOLUME 1, REVISION 1 (Philco Corp.) 122 p

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RECORD OF CHANGES TO DOCUMENT

PHO-1Z4000, Vol I, Rev 1

ISSUED 24 JUNE 1964

Page Sequence of Vol I, Rev 1	
Title Page	-i-
Front Matter	-ii- through -ix-
Section 1	1-1 through 1-3
Section 2	2-1 through 2-7
Section 3	3-1 through 3-64
Section 4	4-1 through 4-239
Section 5	5-1 through 5-6

Change 1 — 22 January 1965

FRONT MATTER

Replace pages -ii- through -ix-.

Remove and destroy pages -x- and -xi-.

SECTION 4

Move Page 4-222 in front of Tab 4.4. (It is now in back of Tab 4.4.)

Move Tab 4.4 to the new Volume IA.

Remove and destroy pages 4-223 through 4-239.

Replace with change pages 4-223 through 4-239.

Insert change pages 4-223 through 4-239 in the new Volume IA.

Section 4.1 through 4.3 now contains pages 4-1 through 4-222.

SECTION 5

Move all of Section 5--Tabs 5.1 through 5.5 and pages 5-1 through 5-6--to the new Volume IA.

PHO-1Z4000
Vol I, Rev 1

GOSS TELEMETRY NETWORK DATA BOOK

CONTRACT NAS 9-1261

APPROVED BY
PHILCO HOUSTON

Submitted to the
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Houston, Texas

Submitted by _____
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PHILCO HOUSTON OPERATIONS
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PHILCO CORPORATION
A SUBSIDIARY OF FORD MOTOR COMPANY

FOREWORD

This document provides a central source of data for the GOSS Telemetry Network and will be revised as necessary to assure availability of this data to all contractors and groups needing this information.

The change pages issued 22 January 1965 are issued pursuant to the statement of work under Task K of PHO-TP8089, the effort for which was directed by Change Notice No. 54, dated 17 December 1964.

Contents of this document reflect the input of various organizations and contractors working toward completion of the GOSS Telemetry Network. Acknowledgement is hereby given to the following organizations and contractors for providing data used in this document:

Bell Telephone Company
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4.4 NEAR SPACE INSTRUMENTATION FACILITIES

The Near Space Instrumentation Facilities (NSIF) (Figure 4.4-1) employed in the GOSS telemetry network for the Gemini program consist of the following tracking stations:

- South Texas Tracking Station
- Grand Canary Island Tracking Station
- Kauai, Hawaii Tracking Station
- Carnarvon, Australia Tracking Station
- Guaymas, Mexico Tracking Station
- Rose Knot Victory (Ship No. 1) Tracking Station
- Coastal Sentry Quebec (Ship No. 2) Tracking Station.

These tracking stations function together to provide world-wide telemetry coverage of Gemini and Agena spacecraft. The South Texas Tracking Station is the only NSIF station that transmits high-speed data to the MSCC, while the remaining NSIF stations convert the telemetry data into teletype summary messages for transmission to the MSCC. In addition to the tracking stations listed above, the GLDS tracking stations function as NSIF tracking stations following launch. (Refer to Paragraph 4.3.)

4.4.1 South Texas Tracking Station

The South Texas Tracking Station is the only exclusively NSIF station that provides telemetry data to the MSCC in real time. In addition, South Texas is the only NSIF station that provides dump telemetry data to the MSCC.

To receive, process, and forward the telemetry data to the MSCC, the South Texas tracking station employs the following equipments:

- Receiving equipment
- Patching and recording equipment
- PCM ground stations

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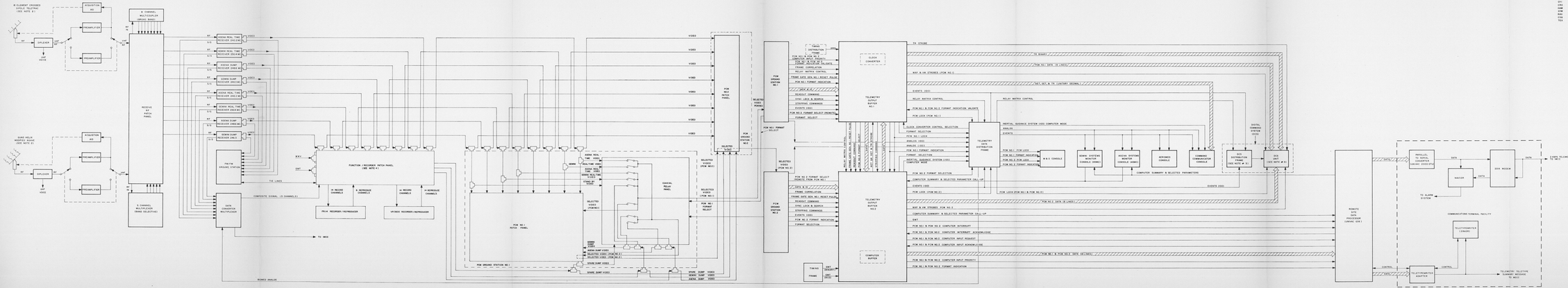

NOTES (UNLESS OTHERWISE SPECIFIED):

1. THIS DRAWING APPLIES TO THE FOLLOWING TRACKING STATIONS, WITH EXCEPTIONS NOTED:

GRAND CANARY ISLAND	(CY)
CARNARVON, AUSTRALIA	(CRO)
KAUAI, HAWAII	(HAW)
GUAYMAS, MEXICO	(GYM)
ROSE KNOT VICTORY	(RKV)
QUARTAL SEMTTH GUERRE	(USQ)
TEXAS TOWER	(TEX)

2. TYPES OF ANTENNAS EXISTING AT EACH SITE AS FOLLOWS:

	M ELEMENTS CROSSED DIPOLE	QUAD HELIX
CNY	1	1
CRO	1	1
HAW	1	1
GYM	1	1
RKV	0	1
USQ	0	1
TEX	0	1

3. EQUIPMENT NOT AT GYM

4. LOCATED IN VARIAN RECORDER/REPRODUCER

Figure 4.4-1 NSIF Telemetry Interface, Block Diagram

- Telemetry output buffers
- Telemetry data distribution frame
- FM/FM biomedical and signal strength equipment
- Display/control consoles
- Remote site data processor
- Communications terminal facility.

4.4.1.1 Receiving Equipment

Receiving equipment consists of the following:

- Two antennas
- Two diplexers
- Preamplifiers (two per antenna)
- An r-f patch panel
- An 8-channel multicoupler
- A 5-channel multiplexer
- Eight VHF receivers.

The r-f signal from the spacecraft is received by the antenna(s) and fed to the diplexer where the VHF telemetry data is extracted and fed to one of the two preamplifiers through a coaxial switch. Normally, preamplifier No. 1 is used; it provides the r-f signal to the acquisition aid for positioning the antenna. When preamplifier No. 2 is used, the associated antenna must be slaved to another antenna. The r-f output of the preamplifier is fed through a second coaxial switch that is ganged to the coaxial switch on the input of the two preamplifiers. From the second coaxial switch, the r-f signal is fed to the r-f patch panel for application to the 8-channel multicoupler or the 5-channel multiplexer. The 8-channel multicoupler provides eight isolated outputs to the r-f patch panel that are identical to the single r-f signal input from the preamplifier. The 5-channel multiplexer contains, in parallel, five sets of cavity filters, all of which are fed from the single r-f signal input. The multiplexer provides the r-f patch panel with five separate r-f signals that are each different from the single r-f signal input from the preamplifier.

At the r-f patch panel, the r-f signals from the multicoupler and multiplexer are patched into the appropriate receivers. The video output of each of the eight receivers is applied to the function/recorder patch panel, PCM No. 1 patch panel, and PCM No. 2 patch panel (patching and recording equipment) through BNC "T" connectors. The signal strength output of each of the eight receivers is fed to the data converter multiplexer. The signal strength outputs of the receivers are thus monitored. In the data converter multiplexer, the signal strength outputs of the receivers are applied to VCO's and signal mixers to form a composite, signal-strength signal for recording purposes. These signals are applied to the function/recorder patch panel in the patching and recording equipment.

4.4.1.2 Patching and Recording Equipment

Patching and recording equipment consists of the following:

- Function/recorder patch panel
- FR114 tape recorder/reproducer
- VR3600 tape recorder/reproducer
- PCM No. 1 patch panel
- PCM No. 2 patch panel
- Coaxial relay panel.

Function/Recorder Patch Panel. The function recorder patch panel provides the capability for cross-patching the video and signal strength signals with the tape recorder/reproducers and the two PCM patch panels. In addition, the function/recorder patch panel provides a monitoring point for all input signals. The patching capability at the function/recorder patch panel is shown in Figure 4.4-2.

FR114 Tape Recorder/Reproducer. The FR114 tape recorder/reproducer is used primarily for recording and reproducing the video signals output from the narrow-band receivers. A total of 14 record channels and 6 reproduce channels is available for recording and reproducing on the FR114.

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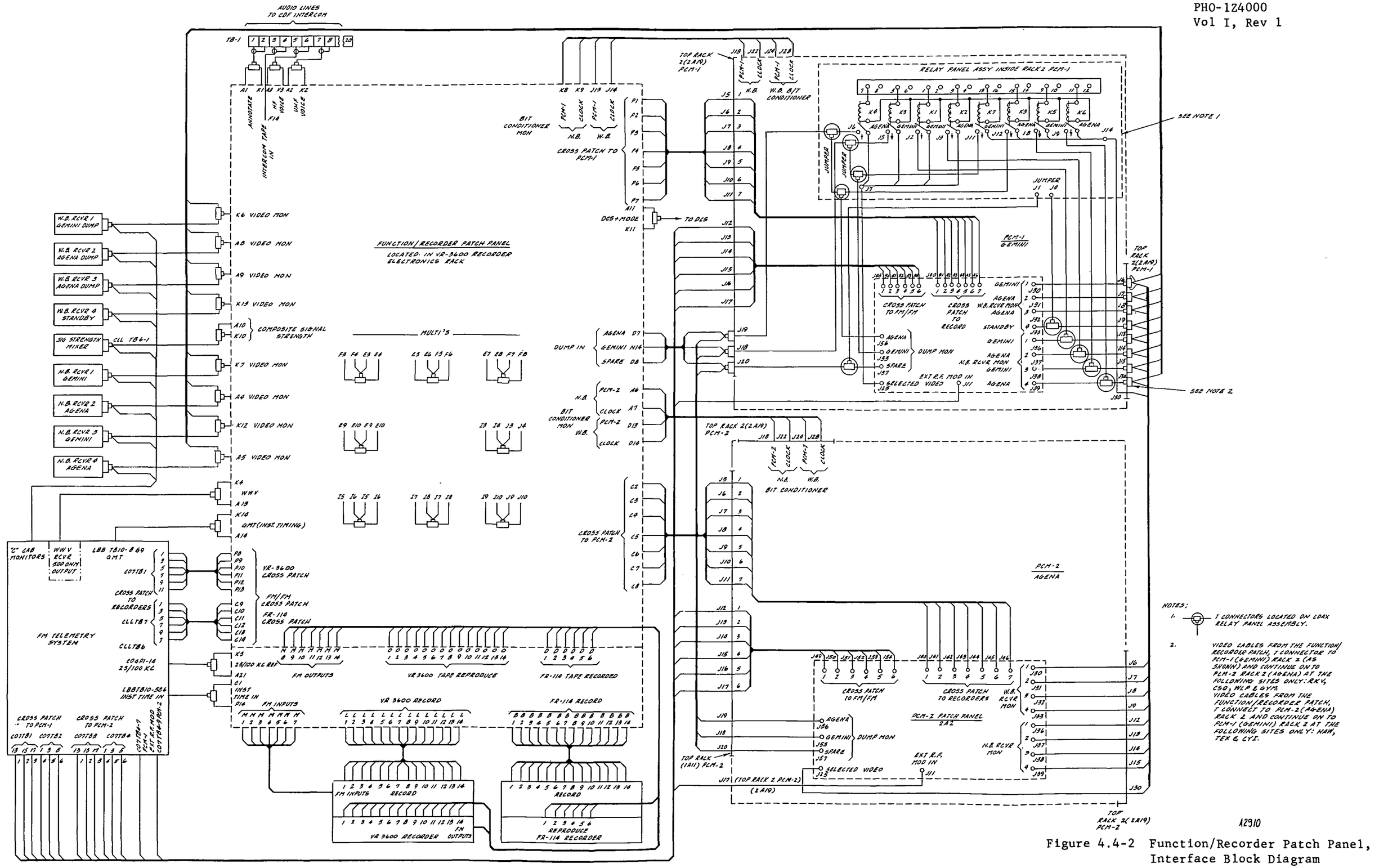

Figure 4.4-2 Function/Recorder Patch Panel, Interface Block Diagram

VR3600 Tape Recorder/Reproducer. The VR3600 tape recorder/reproducer is used primarily for recording and reproducing the video signals output from the wide-band receivers. Signals available for recording on the VR3600 are shown in Figure 4.4-2. A complete description of the VR3600 is contained in Paragraph 4.2.1.3, and the specification is contained in Appendix B.

PCM No. 1 Patch Panel. The PCM No. 1 patch panel is located in PCM ground station No. 1. The video outputs of the receivers are applied to the PCM No. 1 patch panel through a series of BNC "T" connectors. Prior to application to the PCM No. 1 patch panel, five of the video signals (wide-band) are fed through BNC "T" connectors to the coaxial relay panel for switching into the PCM ground stations. The PCM No. 1 patch panel is used to distribute input signals and internally-generated test signals throughout the PCM ground station.

4.4.1.3 PCM Ground Stations

Each PCM ground station receives its serial PCM telemetry input (selected video) from the coaxial relay panel in PCM ground station No. 1. The PCM ground stations at the South Texas Tracking Station are identical to the EMR PCM ground stations used at Cape Kennedy. (Refer to Paragraph 4.3.1.3.) The various outputs of the PCM ground stations are fed to the two telemetry output buffers, the coaxial relay panel, and the telemetry data distribution frame. PCM ground station No. 1 and PCM ground station No. 2 output signals and their functions are as follows:

a. PCM No. 1 Format Select. PCM No. 1 format select consists of four lines applied to the coaxial relay panel for selecting the proper video signal to be applied to PCM ground station No. 1. In addition, through relay closures, PCM No. 1 Format Indication is generated and two of the lines (formats No. 3 and No. 4) generate a Relay Matrix Control signal. (Refer to Paragraph 4.4.1.3 b and Paragraph 4.4.1.3 i, respectively.)

b. PCM No. 1 Format Indication. PCM No. 1 Format Indication consists of four lines fed through TOB No. 1 and the TDDF to the M&O console, and through TOB No. 2 to the computer buffer in TOB No. 2. The four format select pushbutton switches are interlocked so that only one format can be selected at any one time. When a particular format is selected, the associated format indication line is activated, thus lighting the associated format indication lamp on the M&O console. The active format indication line is also sensed by the computer buffer in TOB No. 2 for transmission to the RSDP.

c. PCM No. 2 Format Select. PCM No. 2 Format Select consists of four lines activated in PCM ground station No. 1 and fed through TOB No. 1, TOB No. 2, and PCM ground station No. 2 to the coaxial relay panel. The active input to PCM ground station No. 2 selects the appropriate format for processing the incoming data. The active output of PCM ground station No. 2 is fed to the coaxial relay panel where the proper video signal is selected to be input to PCM ground station No. 2. Through relay closures in PCM ground station No. 2, PCM No. 2 Format Indication is generated. Also, when format No. 1 or No. 2 is selected for PCM ground station No. 2, a Relay Matrix Control signal is generated. (Refer to Paragraph 4.4.1.3 i.) PCM No. 1 Format Select and PCM No. 2 Format Select are both controlled from PCM ground station No. 1.

d. PCM No. 2 Format Indication. PCM No. 2 Format Indication consists of four lines fed through TOB No. 2 and the TDDF to the M&O console and to the computer buffer in TOB No. 2. When a particular format is selected, the associated format

indication line is activated thus lighting the associated format indication lamp on the M&O console. The active format indication line is also sensed by the computer buffer in TOB No. 2 for transmission to the RSDP.

e. Data and ID. The data and ID outputs of each PCM ground station consist of the data received from the spacecraft output in parallel form (8 MSB of 64-bit multiplex output) and the 12-bit identification data in parallel form. The Data and ID outputs of each PCM ground station are fed directly to their associated TOB.

Although the ID output exists to identify each 8-bit data word as it is shifted out of the ground station, it is terminated at the TOB's and is not used.

f. Readout Command. The Readout Command is a 666-nanosecond pulse that is normally used as an "input request" signal to peripheral equipment. This signal, however, is terminated in the TOB and not used in the present equipment configuration. The stripping commands are generated from the readout command within the PCM ground station and are used in place of the readout command.

g. Sync Status. Sync Status consists of 10 lines: main frame search and lock, and subframes No. 1 through No. 4 search and lock. These 10 lines are output from each PCM ground station to their respective TOB for indicating the synchronization status of the PCM ground stations. (Refer to Paragraph 4.4.1.4.1 a.)

h. Frame Correlation. Frame correlation consists of a single-line output from each PCM ground station to its respective TOB. When the PCM ground station receives data, it compares the data synchronization words with internally-stored synchronization words (as patched for that particular data). If the synchronization words are identical, the frame correlation signal is generated indicating that the PCM ground station is synchronized with the incoming data.

i. Relay Matrix Control. Relay Matrix Control consists of a single line output from PCM ground station No. 1 and is fed to the TDDF for switching TOB No. 1 analogs and events to the Agena indicators on the consoles or for switching TOB No. 2 analogs and events to the Gemini indicators on the consoles. In addition, the Relay Matrix Control is used for switching TOB No. 1 and No. 2 data inputs to the DCSDF and the clock converter in TOB No. 1.

The relay matrix control signal is generated whenever PCM ground station No. 1 format, No. 3 or No. 4, is selected or whenever PCM ground station No. 2 format, No. 1 or No. 2, is selected.

j. Stripping Commands. A total of 100 stripping commands is output from each PCM ground station in accordance with the stored program. These commands are multiplexed onto 20 separate lines. The stripping commands output from PCM ground station No. 1 are fed through a buffer amplifier in telemetry output buffer No. 1 to the computer buffer in telemetry output buffer No. 2. The stripping commands output from PCM ground station No. 2 are fed through a buffer amplifier in telemetry output buffer No. 2 to the computer buffer.

The stripping commands are used to strip data from the "data" output of the ground stations for input to the Remote Site Data Processor (RSDP). As selected data is output from a ground station, a stripping command for that particular data word follows by half a word length (78 μsec for Gemini data and 244 μsec for Agena data) for entering the data into the RSDP.

k. Analogs. A total of 100 analog signals can be output on separate lines from each PCM ground station. Each analog signal is a d-c voltage representative of an analog parameter in the spacecraft. The analog outputs from each ground station are fed to the TDDF where they are routed to meters in the TDDF and meters on the various consoles.

l. Events. A total of 100 event signals can be output on separate lines from each PCM ground station. Each event signal represents the occurrence or lack of occurrence of a particular event in the spacecraft. The event signals from each PCM ground station are fed to their respective TOB's for buffering.

m. Frame Gate Generator, No. 1 Reset Pulse. The Frame Gate Generator No. 1 Reset Pulse is a 1-μsec pulse that is generated when the main frame counter is reset to zero. The pulse occurs every 2.4 seconds for Gemini data and every 5 seconds for Agena data. Once the PCM ground station maintains synchronization, the main frame counter starts counting the main frames of data in accordance with the main frame synchronization words contained in the data from the spacecraft. When the counter reaches a preset count, the counter resets and the Frame Gate Generator No. 1 Reset Pulse is generated. The reset pulse is output from each PCM ground station, through its respective TOB to the computer buffer in TOB No. 2.

n. Computer Input Priority. Computer Input Priority consists of two lines output from PCM ground station No. 1 for indicating to the RSDP whether it should accept data from PCM ground station No. 1 or from PCM ground station No. 2. The Computer Input Priority lines are controlled manually from PCM ground station No. 1 and only one line is active at any one time. These lines are fed through TOB No. 1 and TOB No. 2 to the computer buffer.

o. PCM No. 1 Format Indication Validate. PCM No. 1 Format Indication Validate consists of four lines input to PCM ground station No. 1 from the TDDF. The active PCM No. 1 format indication line input to TOB No. 1 energizes a relay that furnishes closed contacts to complete a 28-volt loop. When closed, the 28-volt loop lights the appropriate format indication lamp on the M&O console and lights the lamp on the lower half of the depressed Format Select pushbutton indicator switch on the PCM ground station No. 1 format selection panel, thus providing validation of the selected format.

p. PCM No. 2 Format Indication Validate. PCM No. 2 Format Indication Validate consists of four lines input to PCM ground station No. 1 from the TDDF. The active PCM No. 2 format indication line input to TOB No. 2 energizes a relay that furnishes closed contacts to complete a 28-volt loop. When closed, the 28-volt loop lights the appropriate format indication lamp on the M&O console and lights the lamp in the lower half of the depressed Format Select pushbutton indicator switch on the PCM ground station No. 1 format selection panel, thus providing validation of the selected format.

q. Format Selection. Format Selection consists of four lines output from each PCM ground station Station Input Panel to its respective TOB. These four lines are fed directly through each TOB to the TDDF, where they are terminated. The format select outputs from the Format Select Panel in PCM ground station No. 1 are used in place of the format selection outputs from each PCM ground station.

4.4.1.4 Telemetry Output Buffers

Two telemetry output buffers are provided which interface with the output of the PCM ground stations. Each Telemetry Output Buffer (TOB) provides signal line isolation, signal line interruption, and logic signal driving. Physically located in TOB No. 1 is a clock converter for converting AET, GET, and Tr to unitary decimal and for correcting spacecraft time-to-retrofire (Tr). Physically located in TOB No. 2 is a computer buffer for interfacing with the Remote Site Data Processor (RSDP). In addition, adjacent to each TOB is a 100-channel event recorder for monitoring event signals which are output from its associated PCM ground station.

4.4.1.4.1 Telemetry Output Buffers No. 1 and No. 2

With the exception of peripheral equipment physically located in each TOB, TOB No. 1 and TOB No. 2 are identical. (See Figure 4.4-3.) The inputs to the TOB's are provided by the two PCM ground stations. A functional description of the TOB input signals, the TOB's, and the TOB output signals follows:

a. Sync Status. The 10 Sync Status inputs to each TOB consist of main frame lock and search, and subframes No. 1 through No. 4 lock and search. These inputs are fed into the output buffer subsystem of each TOB where they are fed through power inverters and buffer amplifiers for outputting. The present equipment configuration only warrants the use of two of the sync status lines, subframe No. 1 search and subframe No. 2 search. These two lines are each fed through a power inverter to an AND gate that also accepts a frame correlation signal (Paragraph 4.4.1.4.1 h) through a power inverter. When all three inputs to the AND gate are active, the AND gate produces an active output (PCM lock) that is fed through a buffer amplifier to the computer buffer in

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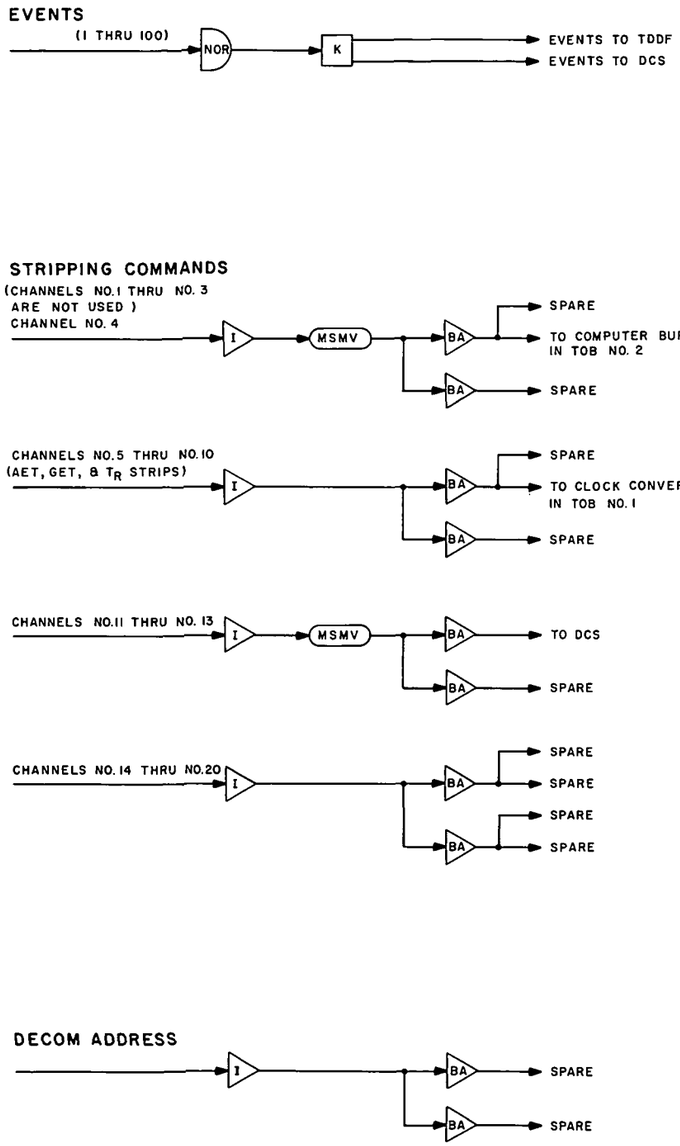

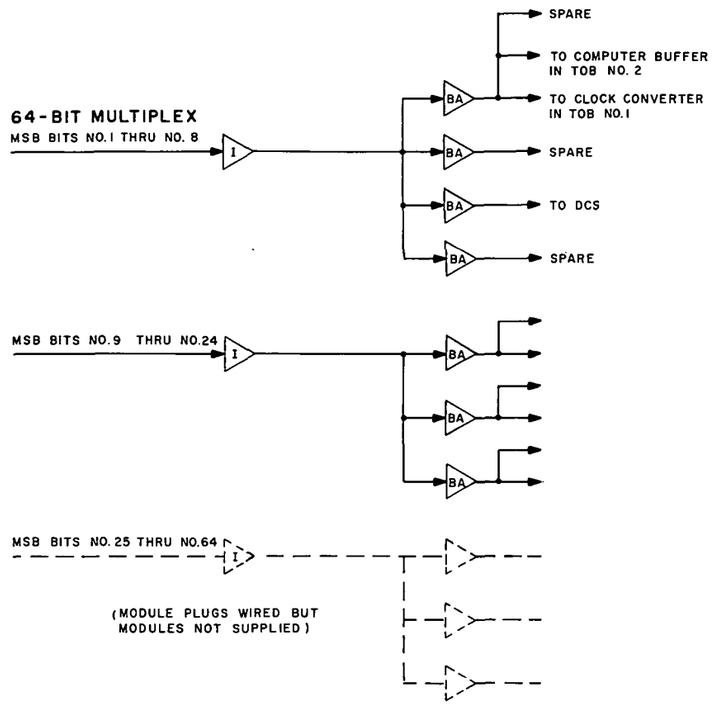

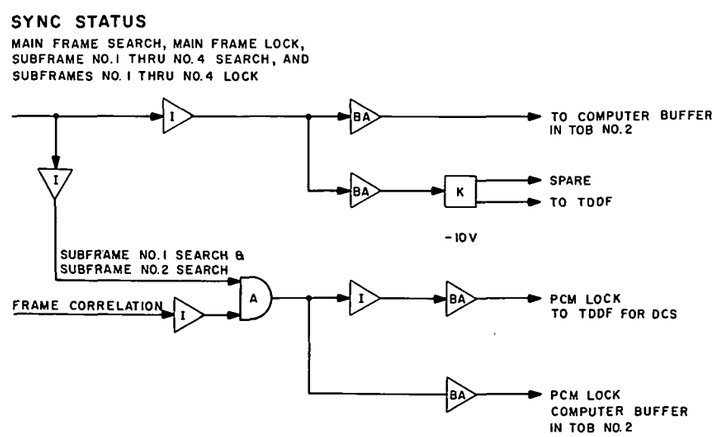
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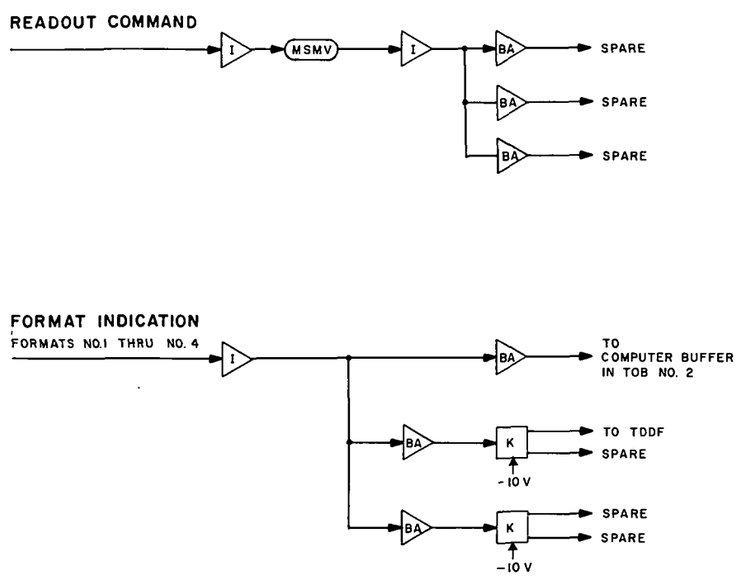
BA
TO COMPUTER BUFFER IN TOB NO.2
K
SPARE
TO TDDF
-10V
SUBFRAME NO.1 SEARCH & SUBFRAME NO.2 SEARCH
FRAME CORRELATION
A
PCM LOCK TO TDDF FOR DCS
PCM LOCK COMPUTER BUFFER IN TOB NO.2



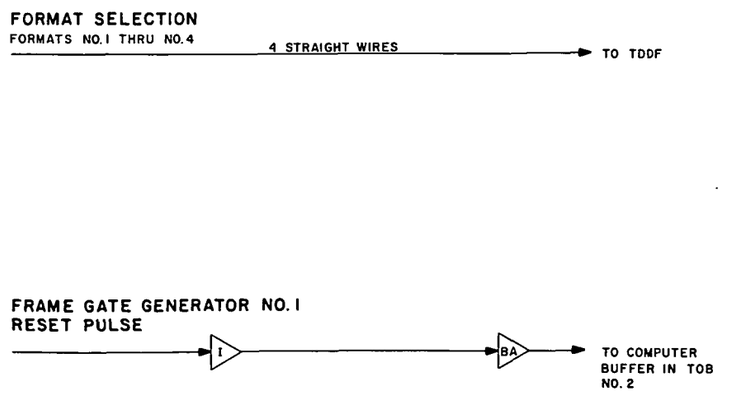


Figure 4.4-3 Telemetry Output Buffer, Logic Block Diagram

TOB No. 2. In addition, the output of the AND gate is fed through a power inverter and buffer amplifier to the TDDF for distribution to the M&O console and the DCS console.

b. PCM No. 1 and PCM No. 2 Format Indication. The format indication lines are input to each TOB from its respective PCM ground station (4 lines each). When activated, each line represents one of the formats being used in its respective PCM ground station. Only one of the four format indication lines from either PCM ground station will be activated at any one time.

Each input line is fed through a power inverter and a buffer amplifier to the computer buffer in TOB No. 2. Therefore, three of the four lines are at a -10-volt level and the fourth line (which indicates the selected format) is at a 0-volt level. In addition, the four format indication lines are each fed through a pair of buffer amplifiers to a pair of relays. The active format indication line energizes the appropriate relay which provides an output to the TDDF for distribution to the M&O console.

c. Data and ID. The data input to each TOB consists of the parallel 64-bit multiplex output from its respective PCM ground station. Although all 64 lines are connected between each PCM ground station and its respective TOB, present data requirements only warrant the use of the eight MSB's of the 64-bit multiplex. Each of the eight input lines to each TOB is fed through a power inverter to two buffer amplifiers. The output of one buffer amplifier is fed to the computer buffer in TOB No. 2 and the clock converter in TOB No. 1. The output of the second buffer amplifier is fed to the Digital Command System (DCS) console.

The ID input to each TOB consists of 12 parallel lines which identify each 8-bit data word as it is shifted out of the PCM ground station. This 12-bit parallel ID data is fed to each TOB from its respective PCM ground station but is not used under the present equipment configuration.

d. Stripping Commands. Each PCM ground station outputs commands (each one usec in duration) to its associated TOB on 20 serial lines (channels). Channels No. 1 through 3 are not used. Channel No. 4 receives the 1-μsec pulses and applies them to a power inverter that provides positive-going, 1-μsec pulses to a monostable multivibrator. The monostable multivibrator expands the 1-usec pulses to 9-μsec pulses. The output of the multivibrator is fed through a buffer amplifier to the computer buffer for entering "data" into the RSDP.

Channels No. 5 through 10 each receive the 1-μsec pulses which are fed through a power inverter and a buffer amplifier to the clock converter in TOB No. 1. These stripping commands are used to enter Gemini Elapsed Time (GET), Agena Elapsed Time (AET), and Time-to-Retrofire (Tr) "data" words into the clock converter.

Channels No. 11 through 13 each receive the 1-μsec pulses and apply them to a power inverter that provides positive-going, 1-μsec pulses to a monostable multivibrator. The monostable multivibrator expands the 1-μsec pulses to 9-μsec pulses for application to the DCS console via a buffer amplifier. Channels No. 11 and 12 are used for entering the velocimeter data words into the DCS console. Channel No. 13 is used for entering the Message Acceptance Pulse (MAP) data words into the DCS console.

Channels No. 14 through 20 are fed through power inverters and buffer amplifiers to output jacks where they are terminated. These channels are not required under the present equipment configuration.

e. Readout Command. The Readout Command is a 1-μsec pulse that is fed through a power inverter to a monostable multivibrator. The multivibrator expands the 1-μsec pulse to a 9-μsec pulse which is fed through a power inverter and buffer amplifiers to output jacks. Under the present equipment configuration, these signals are not used.

f. Events. Events input to each TOB from its respective PCM ground station consist of 100 bi-level signals fed over serial lines. Each input line is fed through one of 100 relay drivers. The output of each relay driver (when active) energizes two form "C" contact relays. One relay provides isolated contact closures for the TDDF, and the other provides isolated contact closures for the DCS distribution frame.

g. Frame Gate Generator No. 1 Reset Pulse. The Frame Gate Generator No. 1 Reset Pulse input to each TOB consists of a single line carrying a 1-μsec pulse. This pulse is fed through a power inverter and a buffer amplifier to the computer buffer in TOB No. 2. When this pulse is not input to the power inverter, the power inverter -10-volt output is amplified by the buffer amplifier and applied to logic circuitry in the computer buffer (along with the PCM lock signal) to generate an interrupt signal for the RSDP.

h. Frame Correlation. Frame Correlation consists of a single line input to each TOB from its respective PCM ground

- Preamplifiers:

  Nems-Clarke Model PR203 (narrow band)

- Receivers:

  Nems-Clarke Model 1415 50 and 100-kc (switchable) IF BW

  Nems-Clarke Model 1434 50 and 100-kc (switchable) IF BW

  Nems-Clarke Model 1455A 100-kc to 1.5-mc IF BW (plug-ins)

- PCM Systems:

  Electro-Mechanical Research Inc. Model MSFTP-1 PCM Ground Station

  Remington Rand UNIVAC Model 1218 Buffer Multiplexers

- Discriminators:

  Bendix Corp. Model TDA-102

  Bendix Corp. Model TDA-300

- Decommutators:

  Arnoux Corp. Model TDS 90/90

- Diversity Combiners:

  Nems-Clarke Model DCA-510

- Magnetic Tape Recorders:

  Ampex Model FR114 14-Track Recorder/Reproducer

  Consolidated Electrodynamics Corp. Model VR-3600 14-Track Recorder/Reproducer

station. When the associated PCM ground station is in synchronization with incoming data, the frame correlation line is active (zero volts). This signal is fed through a power inverter to an AND gate for generating the TOB PCM Lock output signal. (Refer to Item i, below.)

i. PCM Lock. PCM lock is generated within each TOB for use by the computer buffer in TOB No. 2 and the DCS. Subframe Search No. 1, Subframe Search No. 2, and Frame Correlation are input to each TOB from its respective PCM ground station and are all zero volts when the PCM ground stations are in synchronization with incoming data. The three lines are each fed through a power inverter to an AND gate that produces the PCM lock signal. The output of the AND gate is fed through a buffer amplifier to the computer buffer in TOB No. 2 and through an inverter and a buffer amplifier to the TDDF for the DCS.

j. Format Selection. Format Selection consists of four lines input to each TOB from its respective PCM ground station Station Input Panel. These lines are wired straight through each TOB to the TDDF where they terminate. The present equipment configuration employs the format select lines output from the PCM ground station No. 1 Format Select Panel and not the formal selection lines output from each PCM ground station Station Input Panel.

k. Relay Matrix Control. Relay Matrix Control consists of a single line input to the clock converter in TOB No. 1 from the TDDF. When active (ground potential), this line energizes a relay in the clock converter that switches the "data" and stripping commands received from TOB No. 1 and TOB No. 2. (Refer to Paragraph 4.4.1.4.3.)

1. Inertial Guidance System Computer Mode Indication. The Inertial Guidance System (IGS) Computer Mode Indication, which consists of seven lines, is output through the TDDF to the Command Communicator Console. Each line, when active, represents one of the seven different operating modes of the IGS computer in the Gemini spacecraft. The logic circuits that provide the IGS computer mode indication are located only in TOB No. 2.

   The logic employed in providing the IGS Computer Mode Indication to the TDDF and the Command Communicator Console is shown in Figure 4.4-4. The relay matrix control from PCM ground station No. 1 is applied to the decision logic along with format indication (Gemini real-time or Gemini dump) and PCM lock from both PCM ground stations. The decision logic consists of AND and OR gates that accept the aforementioned signals to produce a PCM enable and PCM inhibit, and register reset signals for inputs from PCM ground station No. 1 or No. 2.

   The PCM enable signals activate the selected channel for accepting the three IGS computer mode "data" words and their associated stripping commands for entry into a three-bit register. These three bits summarize, as one bit per mode word, the binary equivalent of the IGS computer operating mode. As the three-bit register stores each bit equivalent, the register provides the bit in data and data-not-output form to the decoding matrix. When the third pair of bit data and data-not outputs from the three-bit register are received, the decoding matrix provides an AND gate enable condition that activates only one of the seven AND gates to produce an

NOTE: THIS NEW PAGE IS ADDED TO VOL. I, REV. 1 OF THIS DOCUMENT, UNDER COVER DATED 24 JUNE 1964.

NEW PAGE
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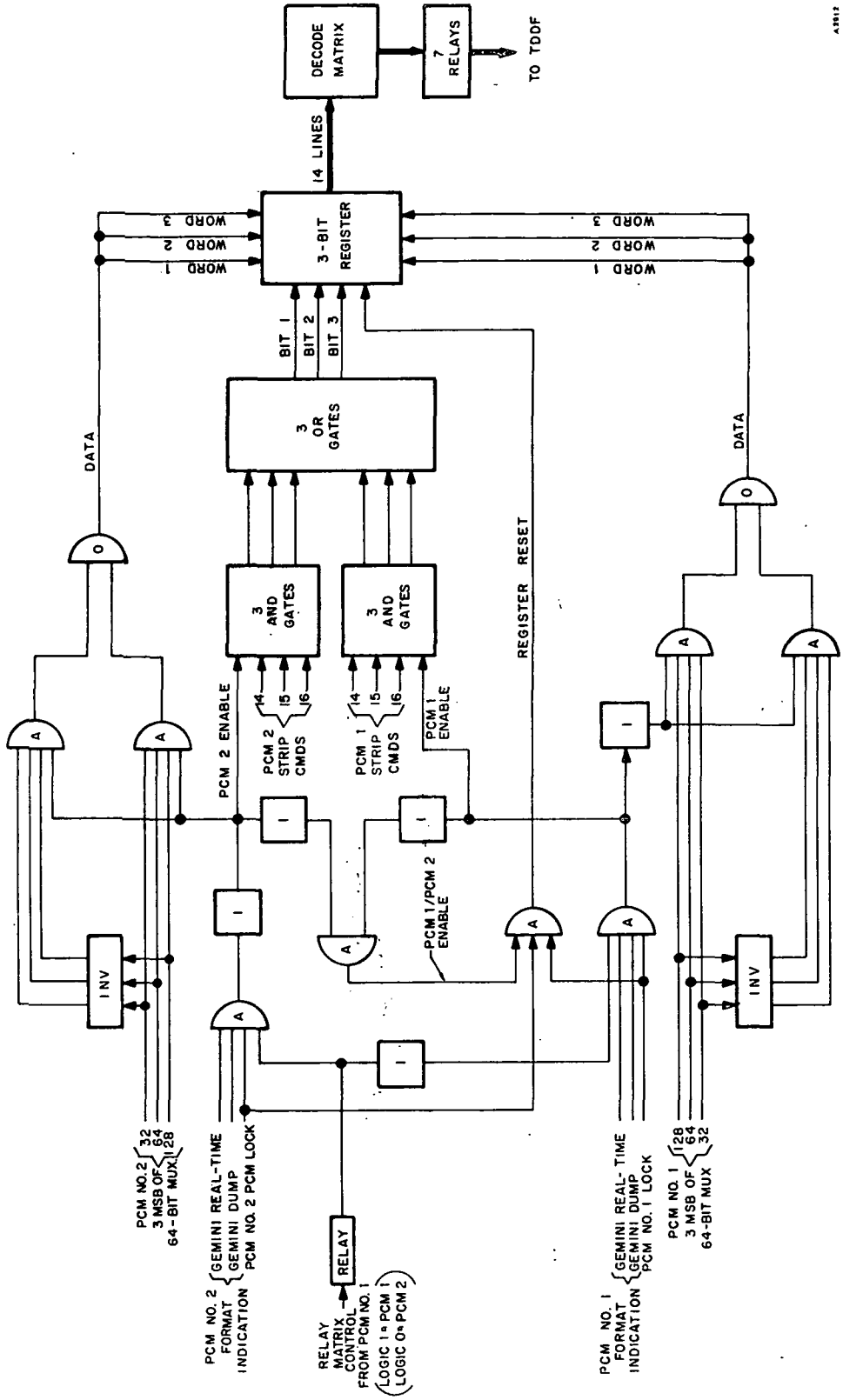

Figure 4.4-4 Telemetry Output Buffer IGS Computer Mode Indication, Logic Block Diagram

output. This AND gate output energizes a relay to provide a relay contact closure for the IGS computer operating mode display on the TDDF and the Command Communicator Console.

4.4.1.4.2 Computer Buffer

The computer buffer (Figure 4.4-5) consists of Gemini and Agena PCM logic, Gemini and Agena Computer Address Matrices (CAM), and Greenwich Mean Time (GMT) logic. These logic sections of the computer buffer function to provide a data entry interface with the RSDP.

a. Computer Address Matrix Logic Section. The Computer Address Matrix (CAM) logic section of the computer buffer (Figure 4.4-6) receives the computer summary and selected parameter call-up lines from the Gemini and Agena Systems Monitor consoles.

The CAM logic circuits are comprised of two identical channels which function with the Agena or Gemini computer storage data. The CAM logic provides the Gemini and Agena Systems Monitor Consoles operators with the ability to generate an 18-bit code address for computer control. The four-by-five switch panel used to provide the control for the two CAM logic channels in the computer buffer unit is shown in Figure 4.4-18.

Six bits of data are directly controlled by the SUM (summary), PRINT-OUT, A (Agena), G (Gemini), TAPE PB (tape playback) and STOP switches (1 through Ø, inclusive). These decimal switches generate a 12-bit 1 - 2 - 4 - 8 BCD word that selectively ranges from 000 to 999. The CLEAR and INT (initiate interrupt) switches, including the ERROR indicator, do not contribute to the 18-bit word structure.

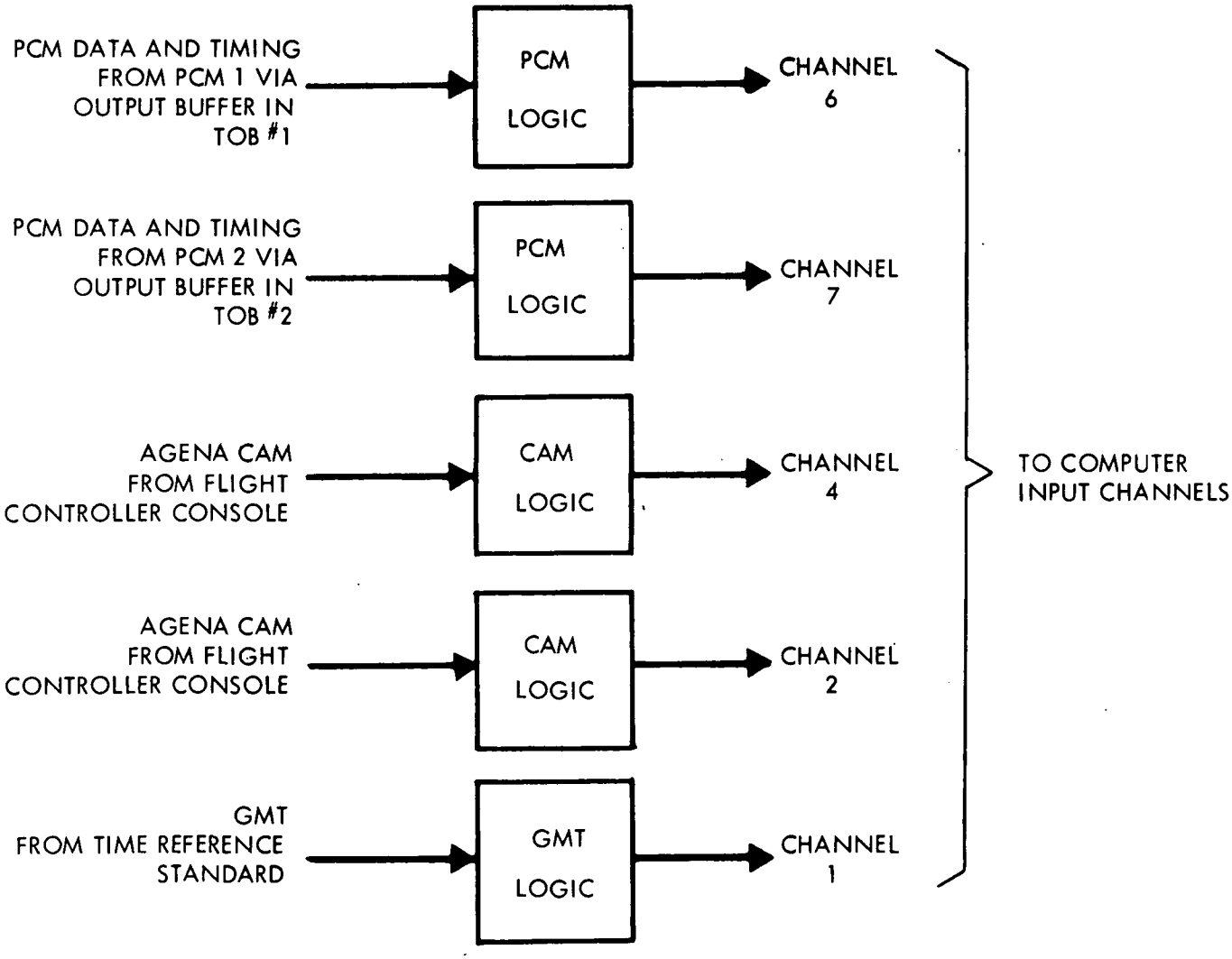
PCM DATA AND TIMING FROM PCM 1 VIA OUTPUT BUFFER IN TOB #1
PCM LOGIC
CHANNEL 6
PCM DATA AND TIMING FROM PCM 2 VIA OUTPUT BUFFER IN TOB #2
PCM LOGIC
CHANNEL 7
AGENA CAM FROM FLIGHT CONTROLLER CONSOLE
CAM LOGIC
CHANNEL 4
AGENA CAM FROM FLIGHT CONTROLLER CONSOLE
CAM LOGIC
CHANNEL 2
GMT FROM TIME REFERENCE STANDARD
GMT LOGIC
CHANNEL 1
TO COMPUTER INPUT CHANNELS

Figure 4.4-5 Telemetry Output Buffer Computer Buffer, Block Diagram

Figure 4.4-6 is a block diagram of the CAM logic. This diagram is identical in the Agena or Gemini CAM applications and the following discussion is applicable to both. Six bits of data corresponding to the A, G, SUM, PRINT-OUT, STOP and TAPE PB switches are loaded directly into the appropriate 6-bit positions of the 18-bit register. These bits remain in the register and on the computer's input lines until the corresponding switches are set to another state.

The remaining 12 bits of data are assigned bit positions 2^0 through 2^1, and are loaded into the 18-bit register under the control of the switch input logic as the operator selections are made on switches 1 through Ø. These switches are normally depressed three times with the first selection loading the corresponding 4-bit binary number into the hundreds portion of the register. The second and third number selections are accordingly converted to 4-bit binary numbers and loaded into the tens and units registers, respectively.

The logic flow for generation of the 12-bit word begins with the initial application of power to the TOB cabinet. At the time power is turned on, the initial condition relay resets all of the CAM logic to zero for a duration of approximately 10 milliseconds. Thus, the 4-bit input register, 8:1 counter, digital filter and delay logic, and interrupt F/F and interface are all reset to initial logic ZERO conditions. Each address switch on the consoles is connected to a separate line. Lines 1 through Ø are supplied with a logic ONE when the corresponding switch or switches are depressed.

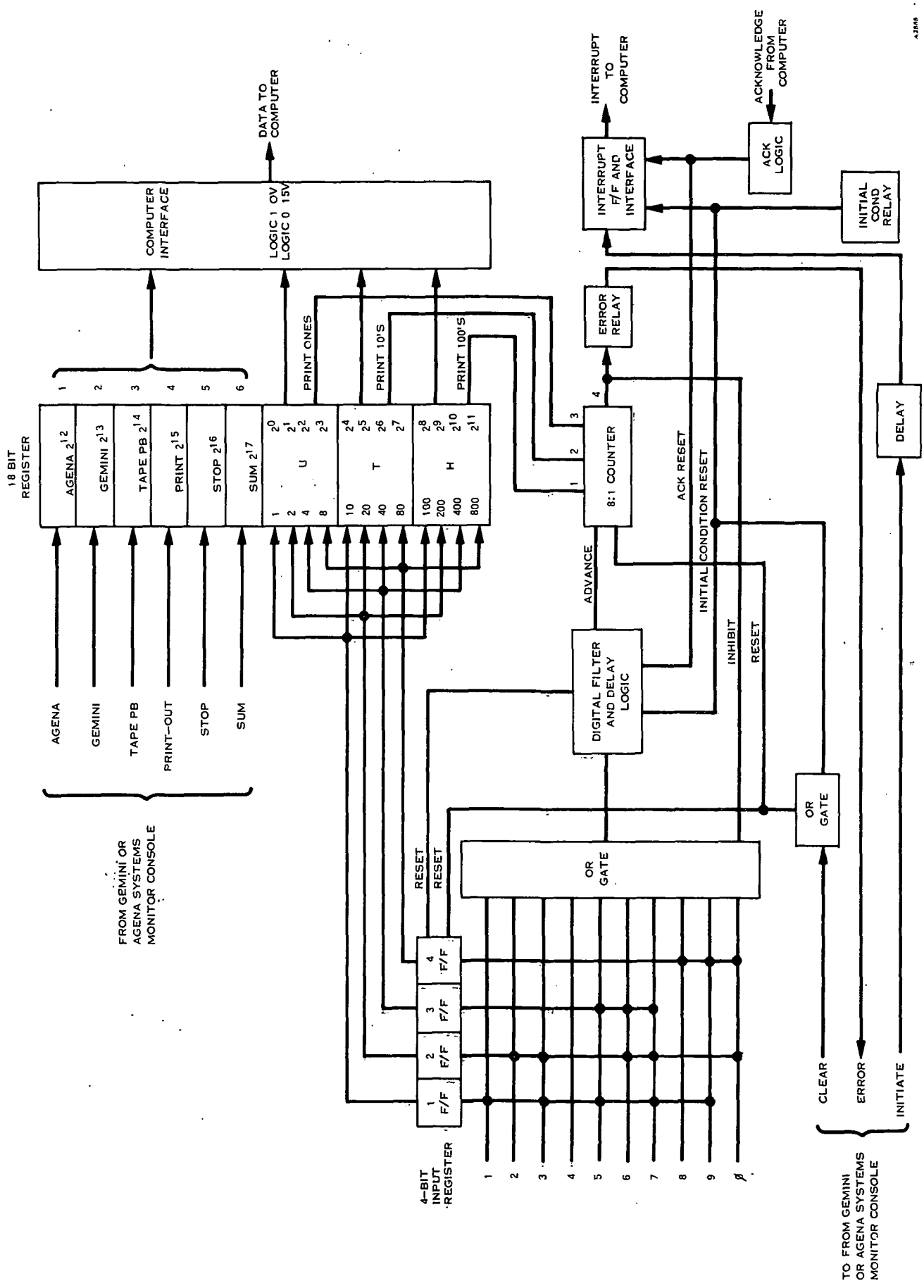

Figure 4.4-6 Computer Buffer Computer Address Matrix Logic Section, Block Diagram

As the switch for a given decimal digit is pressed, a logic ONE (-10 volts) is applied to the corresponding line of the input matrix. This line causes the input -10 volts to be applied to the associated common points of the matrix. These points set the correct states of the flip-flops in the 4-bit input register and advance the 8:1 counter through the OR gates and digital filter and delay logic.

The OR gates function as a buffer between the matrix and the digital filter and delay logic circuits.

The digital filter and delay logic circuits eliminate switch contact-bounce by allowing one clear edge to appear in the output of the filter for each switch depression. As the switch closure is applied to the digital filter and delay logic circuits, a corresponding binary code appears on the steering gates of the 4-bit input register which appears in all three groups of the number register (labeled units (U), tens (T) and hundreds (H)). The filter logic causes the OR'ed switch closure to be delayed for approximately 10 milliseconds to compensate beyond the period of possible switch-bounce. This produces a single, clean, leading edge for use as a trigger. The filtered trigger output is introduced into the 8:1 counter which advances one count from the initial binary state of ZERO to binary ONE.

The 8:1 counter produces a trigger pulse, which corresponds to its binary state (1, 2 or 3), to enable the loading of the code from the 4-bit input register into the hundreds, tens or units register. The loading of the hundreds portion of the 18-bit register is enabled on the count of binary ONE. Tens are loaded on the count of binary THREE. In this manner, each time the operator operates a switch on the address matrix that number is loaded, hundreds first, into the proper register.

For example, on the first switch depression, the steering inputs of the number registers in the 18-bit register are provided with the input binary code which is loaded into the hundreds register on the binary count of ONE in the 8:1 counter. When the switch is released by the operator (after 25 milliseconds for this style of switch), the delay logic produces a reset to the 4-bit input register.

The second switch depression again loads the 4-bit register with the corresponding binary code and, following the 10-millisecond delay, the 8:1 counter advances to the state of TWO. In this state, the counter triggers just the tens portion of the register, causing it to load the binary code appearing on the steering inputs into the register. The 4-bit input register is reset to ZERO when the second switch has been released.

The third switch depression loads the 4-bit input register, which is set to the corresponding binary code and, after a 10-millisecond delay, the switch-closure pulse advances the 8:1 counter to a count of THREE. A THREE state in the counter triggers only the units portion of the 18-bit register, causing it to load the binary code appearing on its steering inputs. Following the operator's release of the third switch selection, the 4-bit input register is reset to ZERO.

If a fourth switch selection has been accidentally made by the operator, these same circuits begin to process the binary number as if it were normal. When the 8:1 counter has been advanced to sense a count of FOUR, however, a -10 volts inhibit level is generated. This level is applied to energize the error relay and also inhibits the input OR gates. The energized error relay causes the ERROR indicator to light on the four-by-five switch matrix at the flight

control console. Inhibiting the OR gate circuits causes the CAM logic to lock and remain locked until the operator initiates a clear gate by depressing the CLEAR switch. The resulting CLEAR resets all of the counters, registers and flip-flops to an initial zero state. The operator can then re-establish his 12-bit code.

Another error condition occurs when for any reason the operator has not completed his selection; then the empty registers will contain only binary zero codes. Binary zeros are sensed by the computer as errors. A decimal Ø (ZERO) is sensed as a binary 10 by the computer and must be selected when a zero is used in the desired computer address word structure.

The generation of the 12-bit BCD code in the 18-bit register is complete when the operator has completed his third switch depression. At this time, the operator depresses the INITIATE switch which, when released, causes a logic ONE to be set on the interrupt flip-flop. This flip-flop, through interface, raises the computer's interrupt line. The computer recognizes the interrupt during its normal priority routine (which is normally recognized within 20 milliseconds) and reads the 18-bit data word into its internal memory.

Following storage of the data word, the computer sends an acknowledge pulse to the acknowledge logic. The acknowledge logic resets the interrupt flip-flop, thereby removing the interrupt from the computer line. The same 12-bit BCD word remains in the register as long as it hasn't been cleared by the operator. In this manner, it is unnecessary for the operator to reset the decimal

switches for re-initiating the same word. When the operator is ready to reinsert a new word, he must depress the CLEAR button to reset the CAM logic to initial zero condition and then set the switches for the desired word.

b. PCM Logic Section. The PCM logic section of the computer buffer (Figure 4.4-7) receives its inputs from each TOB. The inputs from each TOB consist of the following:

- Thirteen bits of data (an 8-bit binary coded data word, four format-indication bits, and a computer input priority bit)
- One line providing pre-patched stripping commands
- One line providing the frame gate generator No. 1 reset pulse
- One line providing PCM lock (PCM ground station synchronization status).

The frame gate generator No. 1 reset pulse is 1-μsec in duration and occurs every five seconds for Agena data. This pulse is applied to an AND gate which also receives the PCM lock signal output from the associated TOB. When these two signals are present at the AND gate, the gate produces a pulse that sets a flip-flop. When set, the flip-flop produces the computer interrupt pulse. The computer interrupt pulse indicates to the RSDP that the data which follows is a new set (master frame) of parameters. Upon receiving the computer interrupt pulse, the RSDP generates an interrupt acknowledge pulse that resets the interrupt flip-flop in the computer buffer. If the RSDP does not generate an interrupt acknowledge pulse, the computer buffer interrupt flip-flop is not reset and the next master frame of data will not be accepted by the RSDP.

NOTE: THIS NEW PAGE IS ADDED TO VOL. I, REV. 1 OF THIS DOCUMENT, UNDER COVER DATED 24 JUNE 1964.

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22 JANUARY 1965

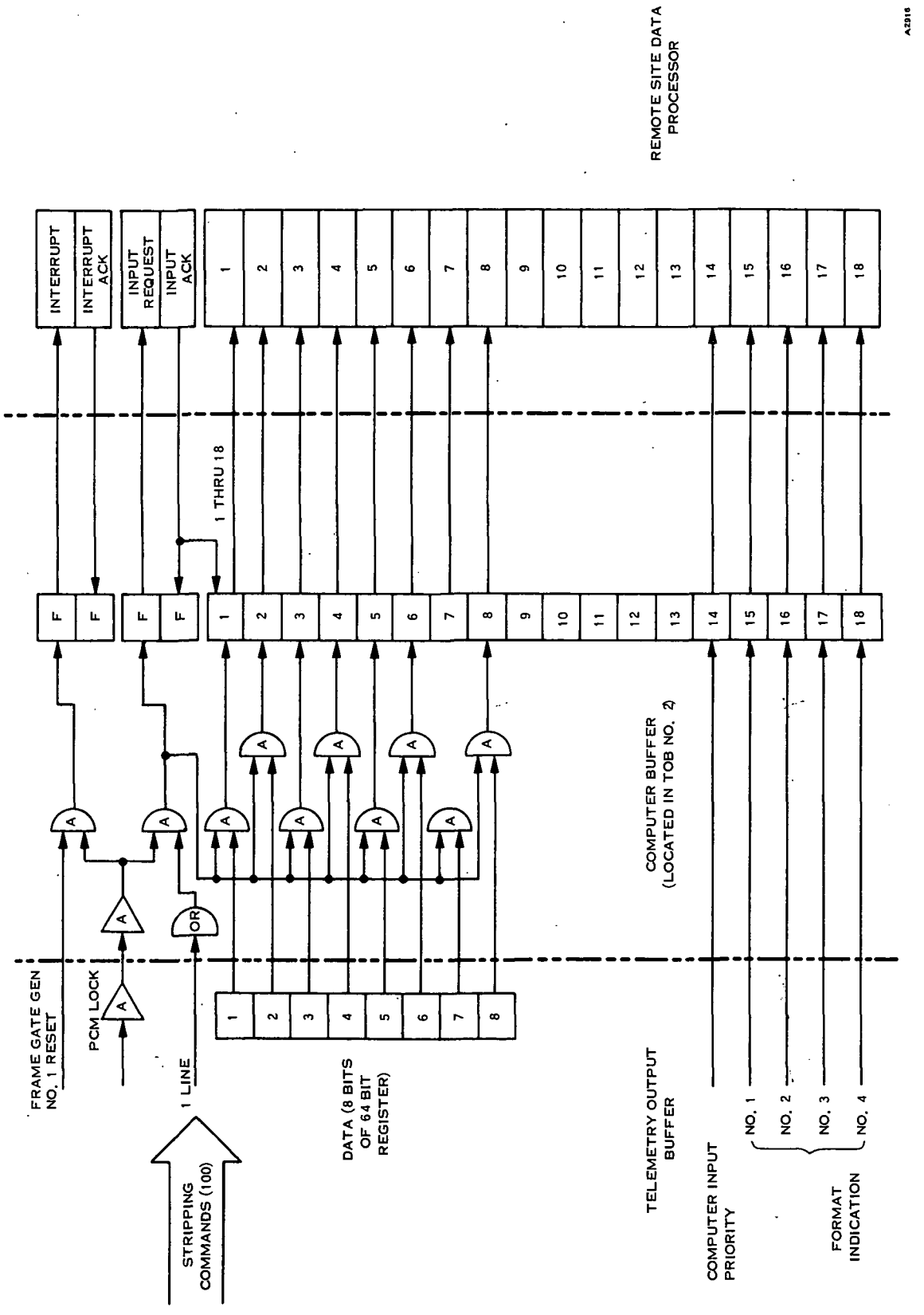

Figure 4.4-7 Computer Buffer PCM Logic Section, Block Diagram

The PCM lock signal is also applied to a second AND gate along with the stripping commands. The output of this AND gate is fed to eight data AND gates that also receive one of the eight bits of data. The output of each data AND gate is then entered into an 18-bit shift register.

The output of the PCM lock and stripping command AND gate is also fed to a flip-flop that produces a computer input request signal that is fed to the RSDP. This indicates to the RSDP that data is on the input lines to the RSDP. The RSDP then generates a computer input acknowledge signal that is fed back to the PCM logic and gates out all of the data in the 18-bit shift register. Data contained in the 18-bit shift register consists of the eight bits of telemetry data, four bits of format indication, and one bit of computer input priority data (accept data on channel No. 6 or accept data on channel No. 7).

c. Greenwich Mean Time Logic Section. Figure 4.4-8 illustrates that the Greenwich Mean Time (GMT) clock is presented to the computer buffer as a 1 - 2 - 4 - 8 binary-coded decimal (BCD) word through a series of relay closures. The computer buffer function is to present the data word to the RSDP and place an interrupt signal on the computer interrupt line as the mean time is updated each second.

An intermediate flip-flop storage register is inserted to maintain the same isolation and interface in the five input channels. This flip-flop register follows the input code in the relays and drives the interface circuits to the RSDP data input lines with the correct logic voltages.

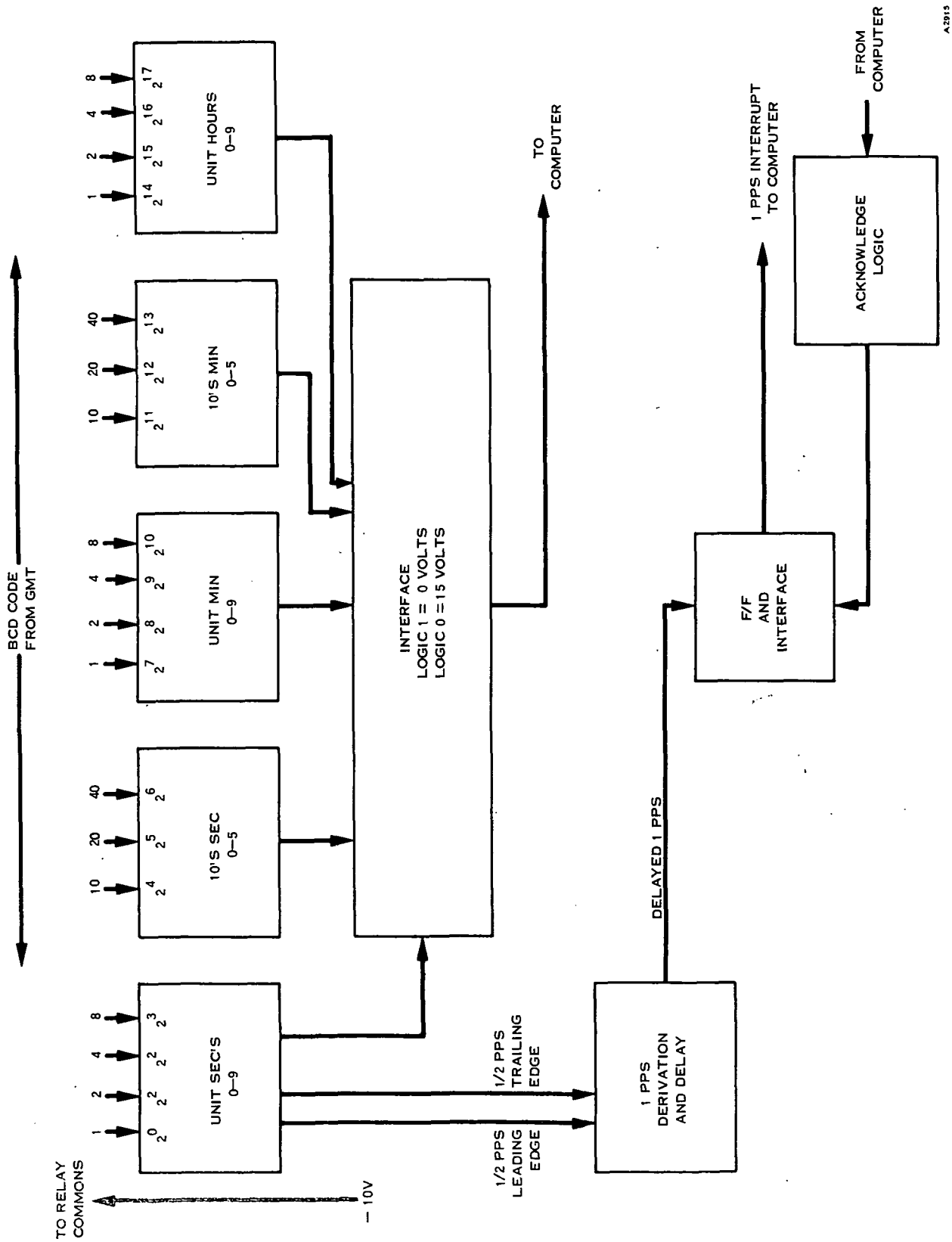

Figure 4.4-8 Computer Buffer GMT Logic Section, Block Diagram

An interrupt signal occurs each second to transfer the GMT data into the RSDP as it is updated each second. Sufficient delay is incorporated to avoid the effects of relay-bounce and to allow the data lines to settle. This results in an updated and stabilized data transfer to the RSDP memory.

The interrupt flip-flop is set by a one pulse per second (1 pps) rate derived from the "ones of seconds" flip-flop which operates at a one-half pulse per second (1/2 pps) rate. Both the leading and trailing edges of this flip-flop are used to trigger delay circuits which are OR-gated to provide the 1 pps rate. A 40-millisecond delay period is introduced to permit the data lines to stablize before the interrupt signal is placed on the RSDP line.

When the interrupt signal is recognized by the RSDP, the time code is read from the lines. The RSDP then provides an acknowledge signal to the acknowledge logic in the computer buffer. This logic resets the interrupt flip-flop and removes the interrupt signal from the line. Each time the clock is updated, at one-second intervals, this process is repeated.

The GMT clock reads a maximum of 23 hours, 59 minutes and 59 seconds. Twenty bit positions in BCD code are required to accumulate this time. Since the RSDP input channels contain only 18 data lines, the maximum time code which can be entered is 9 hours, 59 minutes and 59 seconds. Therefore, it is necessary to manually read the "tens of hours" into the RSDP to reference real time within the 24-hour period. The RSDP can then detect the number of "carries" from the "ones of hours" decade and thereby maintain real time following the introduction of initial time.

4.4.1.4.3 Clock Converter

The clock converter converts binary-coded time words that are received from the Gemini and Agena space vehicles to unitary decimal time. The unitary decimal time conversion is produced in hours, minutes and seconds and is displayed locally on a control panel and used to drive console displays. The input signals are in the form of logic levels from the combined operations of two identical telemetry output buffers. TOB No. 1 contains one output buffer section and the clock converter; the second set of inputs is processed by the output buffer in TOB No. 2.

Figure 4.4-9 is a block diagram of the spacecraft clock converter. Two clock inputs, shown as data in Figure 4.4-9 corresponding to the Gemini elapsed time (GET) and Gemini time-to-retrofire (Tr) clocks, are received from the Gemini spacecraft via one PCM telemetry link. One clock input called Agena Elapsed Time (AET), is received from the Agena space vehicle over another PCM telemetry link. The Gemini and Agena PCM Telemetry clock signals are processed from the two telemetry output buffers by an input circuit which is relay controlled. This is done to provide switching between the active systems in the event of single or dual space vehicle operations.

Unitary decimal output signals are produced in the form of relay closures which serve to isolate the TOB processing logic circuits from the load circuits and provide switching power for driving the end circuits in a remote location. The sections which functionally make up the clock converter are: the input switch-relay section, the GET clock converter, the Tr clock converter and the AET clock converter:

a. Input Switch Relay Section. By relay closure, the input switch relay section switches Gemini data or Agena data contained in the two separate TOB's to the clocks in the clock converter. Either TOB is capable of supplying the Gemini or Agena data to the clock converter. Time data is switched by the input switch relay section to apply the correct data to the proper clock.

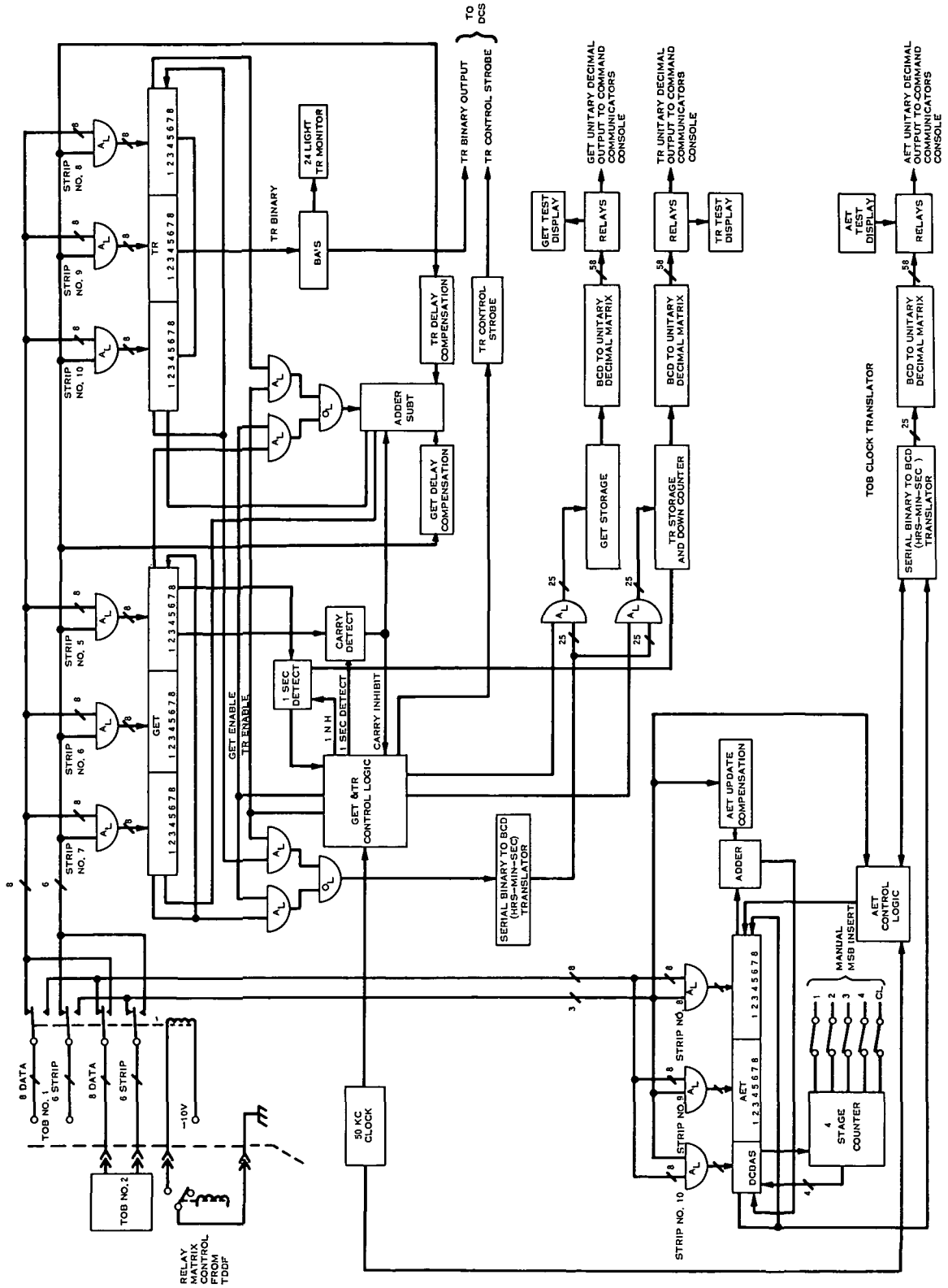

Figure 4.4-9 Telemetry Output Buffer Block Converter, Block Diagram

The electrical association between the TOB's and clock converters is shown in Figure 4.4-10. Inputs received by the input switch relay section are eight output "data" bits from the 64-bit register in the TOB's, and six stripping outputs.

During normal operation, the input switch relay is in the de-energized state which permits application of Gemini data (from PCM ground station No. 1) to the GET and Tr clock converters and Agena data (from PCM ground station No. 2) to the Agena clock converter. If for some reason PCM ground station No. 1 has to be switched over to process Agena data, the input switch relay is energized by the relay matrix control signal. When energized, the Agena data from PCM ground station No. 1 is applied to the AET clock converter and the Gemini data is applied to the GET and Tr clock converters. The same switching configuration applies to PCM ground station No. 2 being switched over to process Gemini data.

b. Gemini Elapsed Time (GET) Clock Converter Section. The GET clock converter portion of the clock converter is comprised of a 24-bit serial input register, an adder-subtractor, control logic, a carry and one-second detect circuit, translator, binary-to-unitary-decimal matrix and appropriate output circuits. The adder-subtractor control logic and translator are used on a time-shared basis with the Gemini Tr clock converter portion (see Item c.).

Inputs are sent to the GET register on eight data lines which are supplied by the input switch-relay section. The input for the GET clock is comprised of 24 bits, which are divided into three 8-bit words or three syllables. One

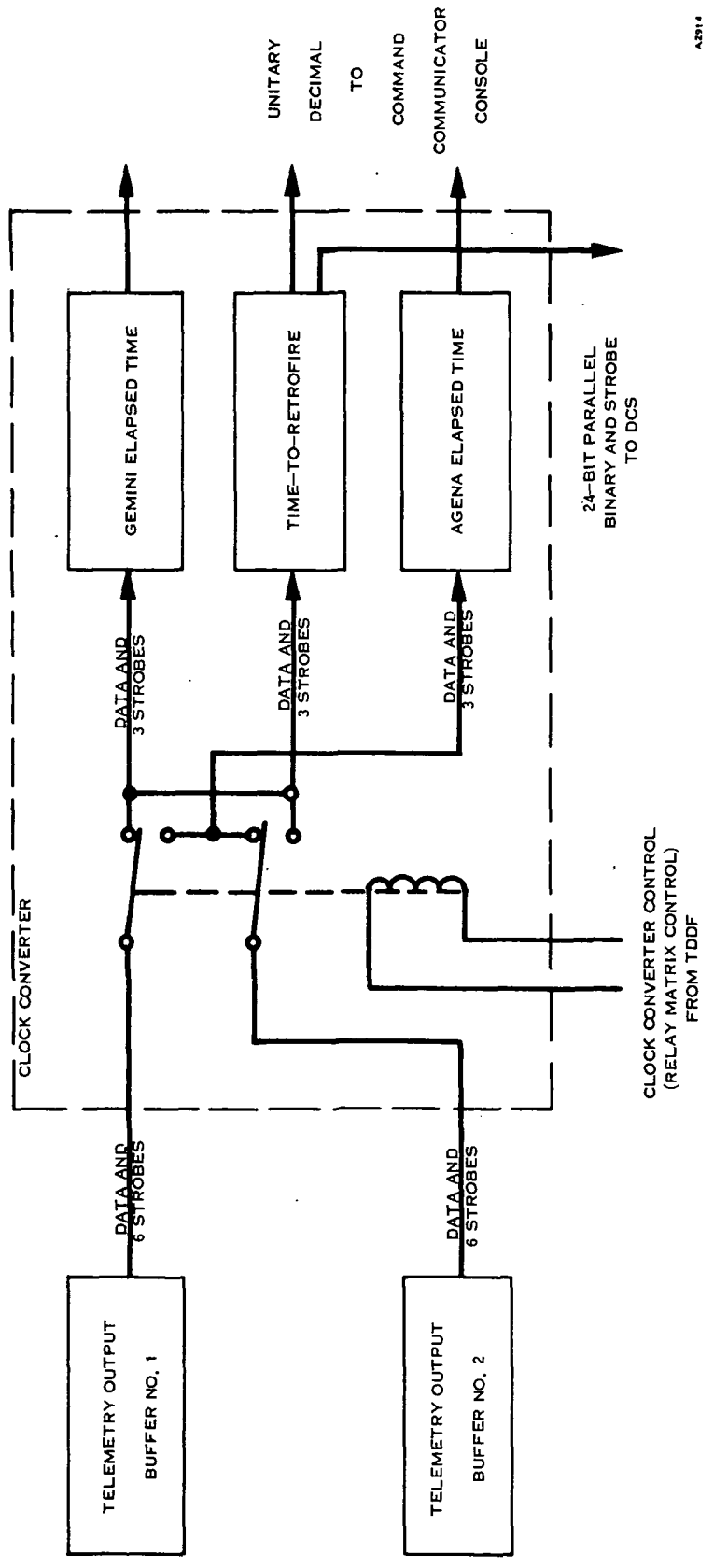
UNITARY DECIMAL TO COMMAND COMMUNICATOR CONSOLE
GEMINI ELAPSED TIME
TIME-TO-RETROFIRE
AGENA ELAPSED TIME
24-BIT PARALLEL BINARY AND STROBE TO DCS
DATA AND 3 STROBES
DATA AND 3 STROBES
DATA AND 3 STROBES
CLOCK CONVERTER
CLOCK CONVERTER CONTROL (RELAY MATRIX CONTROL) FROM TDDF
DATA AND 6 STROBES
DATA AND 6 STROBES
TELEMETRY OUTPUT BUFFER NO. 1
TELEMETRY OUTPUT BUFFER NO. 2

Figure 4.4-10 Clock Converter Input Switching, Block Diagram

readout identification pulse is provided for each syllable and each readout pulse is received by the register on a separate line. The least significant syllables are supplied to the register at a 2.4-cps rate, thus causing an overflow. This overflow is then inserted into the adder-subtractor circuit. During the next cycle, the adder-subtractor adds this bit to the ninth bit of the overall register.

Data granularity of the GET clock is one-eighth of a second; therefore, when the least significant bits come in every one-tenth of a second, there is a possibility that the same data can be inserted into the register twice. Provision has been made to disable the carry-detect circuit and the one-second detect circuit for one register insertion time after detecting the carry or one-second pulse. The one-second detect circuit is used to commence translation of the GET and also to initiate the countdown of the Tr storage. The GET-Tr translator is time-shared for the GET and Tr clocks.

The normal operation cycle of the GET clock commences with the first least-significant group of eight bits being fed into the register along with the two more significant groups of eight bits of data. This data is run through the adder each time the LSB, 8-bit group is received. When the last 8-bit group has been loaded into the register, all of the data are circulated in serial form through the adder-subtractor. The data is then reinserted into the binary register. At that time (every whole number of seconds following the adder-subtractor insertion), the data is shifted out of the register--most significant bit first--in serial form to the translator.

The translator portion accepts the serial data input and decodes it. The output from the translator is fed in parallel form to the GET storage register, which applies the parallel data to the BCD-to-unitary-decimal matrix. The matrix, in turn, supplies the output relays and unitary decimal displays (on the control panel) with outputs in unitary decimal form for application to the Command Communicator's Console and other remote locations. During the period that the data was circulated through the adder-subtractor, an update compensation which is controlled by a selector switch on the control panel is also inserted into the data. Thus, the same cycle of operation not only includes the insertion of a carry feature but incorporates the use of manual compensation of the GET data as well.

c. Time-of-Retrofire (Tr) Clock Converter Section. The time-of-retrofire clock is similar to the GET clock except that the eight least significant bits for the Tr occur at the same rate as the most significant bits, every 2.4 seconds. The eight least significant bits are also contained in Gemini format word 124. The Tr clock makes use of the same data lines (eight per parallel output) which are common to the GET clock; however, the three readout commands (one for each 8-bit word group) are on separate lines.

A cycle of operation for the Tr clock is similar to the GET clock except that the Tr clock counts from a number down rather than from a lower number progressively up. The Tr storage is counted down in one-second units with the action of the one-second detect circuit which is used to commence translation of the GET as well. Each 8-bit

group is sequentially fed into the Tr register--starting with the least significant group and progressing toward the most significant group.

When the most significant eight bits are completely inserted, the Tr clock is started and the Tr binary register serially shifts through the adder-subtractor. Tr delay compensation is established by a selector switch on the test panel and is subtracted from the Tr data time in the adder-subtractor. The resultant time is then reinserted into the Tr binary register. As soon as the reinsertion cycle has been completed, the Tr clock starts again and shifts out Tr binary data--most significant bit first--from the Tr register and is serially applied to the GET-Tr translator. The data is then decoded in the translator and applied in parallel to the storage register. From the storage register, the data is then applied in parallel to the BCD-to-unitary-decimal matrix. The unitary decimal matrix provides outputs to the relays and unitary decimal displays, and provides for the Tr unitary decimal output.

In addition, when the data is being shifted into the translator it is also fed back to the binary register in order to provide for a Tr binary output from the circuit. When the Tr binary register has settled--following the end of a translation of data--a control strobe is generated as a readout for the Tr binary outputs. The unitary decimal output is fed to the Command Communicator's Console and the binary output is fed to the DCS Console.

Data and stripping outputs for the Tr and GET clocks are normally supplied by TOB No. 2. AET data and stripping are normally supplied by TOB No. 2. The input switch-relay

circuit provides for the reversal of this data assignment. TOB No. 2 could supply GET and Tr information while TOB No. 2 could supply AET with equal proficiency. The number one GET and Tr lines are the most significant in each data group of eight bits, and AET line number one is the least significant bit of each group of eight data bits.

d. Agena Elapsed Time (AET) Clock Converter Section. The Agena Elapsed Time clock is similar in operation to that discussed for the GET and Tr clock converters. The AET clock information is composed of 17 bits--two 8-bit data words and the first bit of the third most significant 8-bit word group. The most significant bit is the first bit of the third 8-bit word.

The input data is converted to AET unitary decimal hours, minutes, and seconds. The data granularity for the AET clock is one second. Operation of the AET clock is similar to that described for the Tr and GET clocks. The operation cycle begins with the data bit being applied--eight bits at a time, the least significant syllable first and progressively continuing toward the most significant bits.

At the conclusion of the last data bit being applied to the AET register, the total register data is contained in 17 bits. The stripping pulses are the same for the AET register as those pulses used on the Tr clock with regard to their order except they are supplied by a different TOB. In this respect, the stripping outputs applied to the AET originate from a different PCM subsystem which is also patched in a different manner, and the resultant data that is supplied is correspondingly different.

These stripping channels are the same, but they do not come up with the same word. When the AET binary input register is filled with the most significant bits, the binary register is serially cycled through the adder circuits. At this time, the insertion of the AET compensation is added to the AET data in the adder and the resultant data are then reinserted into the AET binary register. The AET compensation circuit is controlled manually from a control located on the test panel.

Immediately following the reinsertion of data into the register, the four-stage memory and counter output, the strobes, and any total that has been picked up in the counter is reinserted into the AET binary register. When this transferral and reinsertion is completed, the entire binary register is serially shifted out, most significant bit first, to the AET clock translator. The AET clock data is then decoded in the translator and the translator retains this information. The AET clock translator is not time-shared as described for the GET and Tr translator, and is therefore capable of feeding the output parallel data to the binary-to-unitary-decimal matrix for the AET conversion. The AET binary-to-unitary-decimal matrix then provides its output to drive the unitary decimal display on the indicators on the control panel, relays and outputs for the Command Communicator's Console and other remote locations.

A four-stage counter memory has been added to the AET clock to extend the 17 bits to 21 bits, thus giving the AET clock a 600-hour capability. This four-stage memory functions to accept the overflow from the 17th bit (MSB) as it changed from a ONE to a ZERO (the carry notation). This overflow change is counted, stored, and reinserted at the appropriate

time into the AET binary register. The manual capability of the counter memory can be optionally controlled by pushbutton switches 1, 2, 3, and 4 located on the control panel, or they may be cleared by the CL pushbutton switch located on the same panel.

4.4.1.5 Telemetry Data Distribution Frame (TDDF)

The TDDF (Figure 4.4-11) accepts telemetry event signals from both telemetry output buffers and telemetry analog signals from both PCM ground stations. Other inputs to the TDDF include equipment status information, PCM ground station sync status information, PCM lock, a relay matrix control signal, PCM format indications, and IGS computer mode information.

Incoming signals are distributed either through a patch panel or taper-pin block panels. PCM ground station and telemetry output buffer output signals are routed through the relay matrix and terminated at the patch panel. The recorder input, FM/FM analogs, and PCM ground station sync status signals are routed directly to the patch panel. Equipment status information received from the M&O console is fed directly to the output taper pin blocks for distribution.

The TDDF relay matrix contains the circuits to switch telemetry analog input signals from PCM-1 to PCM-2 and event signals from TOB-1 to TOB-2. The matrix contains 306 relay circuits connected in such a manner that only one input control signal is required to switch the entire matrix. The control signal is initiated at PCM ground station No. 1. With the matrix in the PCM-1 mode, information is received from PCM ground station No. 1 and telemetry output buffer No. 1; in the PCM-2 mode, information is received from PCM ground station No. 2 and telemetry output buffer No. 2. After passing through the relay matrix, all telemetry inputs are terminated at the respective patch panel positions. With the inputs patched to the various display console positions, telemetry information from the units which are switched into the system will be displayed at the consoles. A control for local switching of the matrix is provided on the relay matrix panel.

In addition to the telemetry input signals and display equipment connections, various relay circuits contained in the TDDF are terminated at the patch panel. These circuits include the meter relays used to convert

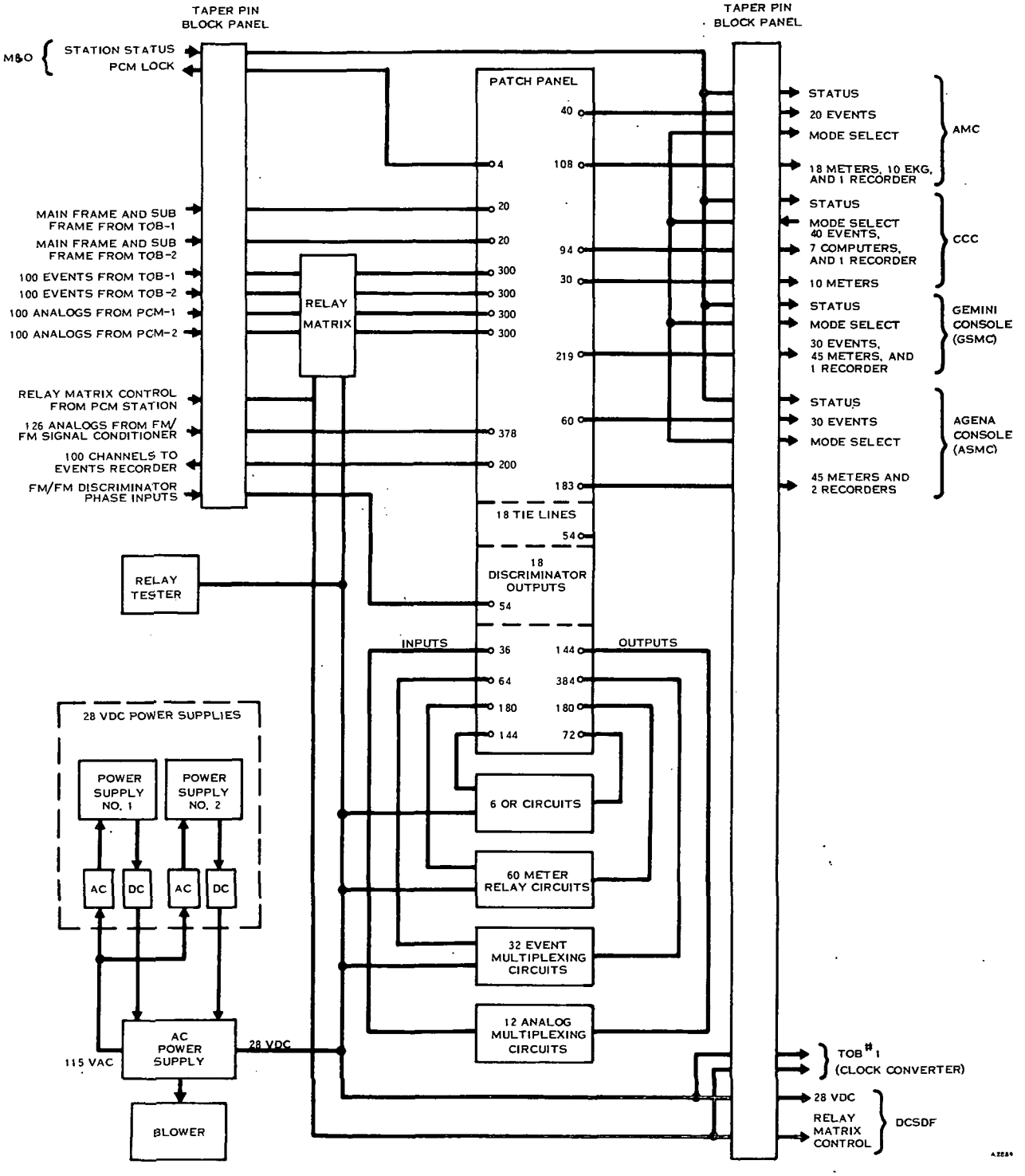

Figure 4.4-11 Telemetry Data Distribution Frame, Block Diagram

analog signals to event signals, multiplexing relay circuits, and OR gate relay circuits. With these additions to the direct patching capability, many functional arrangements can be set up and easily changed by use of pre-patched front boards.

A maximum of 60 analog signals can be displayed on the meter relay panel. Each meter contains upper and lower limit sensing circuitry for producing an out-of-limits signal that is available on the patch panel for routing to any display console or other patch panel functional position.

Six 12-input OR gate circuits with five isolated outputs are provided in the TDDF. The OR gate inputs and outputs terminate at the patch panel, providing the capability of patching up to 12 event input signals to a single OR circuit to receive an event indication at as many as five different output positions when any of the 12 event signals are input.

There are 32 patch panel event multiplexing circuits which allow one event input to be routed to a maximum of four other patch panel positions. The outputs may be patched either from the normally open or normally closed relay contacts. Each output is a separate, isolated relay circuit which may be patched directly to a display console event position or to other patch panel functional circuits.

There are 12 analog multiplexing circuits which do not use relay circuits that consist of five patch panel positions wired in common at the back of the patch panel. Thus, one analog input can be patched to as many as four different patch panel positions.

The patch panel provides connecting positions for the FM/FM ground station discriminator outputs and 18 tie lines. The 18 discriminator outputs from the FM/FM signal conditioner may be patched to the tie line positions for routing the signals back to the FM/FM station or may be patched

to other patch panel positions. Similarly, the tie line positions may be patched to other functional positions for the routing of information between the TDDF and the FM/FM patch panel.

The patch panel provides connecting positions for each of the 100 event recorder channels. The FM/FM ground station events recorder will record, as an event function, any input ranging from 3 to 20 volts. Thus, up to 100 analog signals may be routed through the TDDF patch panel to the FM/FM station recorder for a permanent record.

The patch panel provides connecting positions for two PCM sync lock circuits. Each PCM sync lock signal consists of an AND gate that accepts the main frame and subframe sync outputs of a PCM ground station. When all of the PCM ground station sync status outputs are present at the input of the AND gate, the AND gate produces an output signal called PCM lock. This signal lights a lamp on the M&O console for its associated PCM ground station.

4.4.1.6 FM/FM Biomedical and Signal Strength Equipment

The FM/FM Biomedical and Signal Strength equipment (Figure 4.4-12) consists of an FM/FM ground station and a data converter multiplexer. The signal strength outputs of the receivers are fed to the data converter multiplexer where they are used to modulate VCO's for recording purposes. The video outputs of the receivers are fed to a patch panel in the FM/FM ground station for distribution to recorders, discriminators, etc.

The biomedical analog parameters stripped from the pulse train are applied to the data converter multiplexer from the TDDF. Each biomedical analog parameter frequency modulates a VCO. The modulated output of each VCO is fed to a mixer amplifier that places the frequency division multiplexed FM biomedical data on a 3-kc voice line for transmission to the MSCC.

(To be supplied.)

Figure 4.4-12 FM/FM Biomedical and Signal Strength Equipment, Block Diagram

4.4.1.7 Display/Control Consoles

The display/control consoles provide control and monitoring facilities for various spacecraft and ground equipment functions. The following consoles are provided for this purpose:

- Maintenance and Operation (M&O) Console
- Gemini Systems Monitor Console (GSMC)
- Agena Systems Monitor Console (ASMC)
- Aeromed Console
- Command Communicator Console.

Maintenance and Operation (M&O) Console. The M&O Console (Figure 4.4-13) provides facilities for display and control of telemetry, timing, command, and communications data. Two control panels are provided for this purpose:

a. Right-Hand Display and Control Panel. The right-hand display and control panel (Figure 4.4-14) displays telemetry equipment operating modes and provides the capability of initiating transmission of equipment status information to the other consoles. Status control and display devices consist of 15 alternate-action illuminating pushbutton switches. Mode displays include 20 indicators, 10 for Gemini and 10 for Agena. This panel also contains a GMT display and two controls for updating the "days" digits on all GMT displays at South Texas.

Table 4.4-1 contains a list of the controls and indicators on the right-hand control panel of the M&O console by name and function.

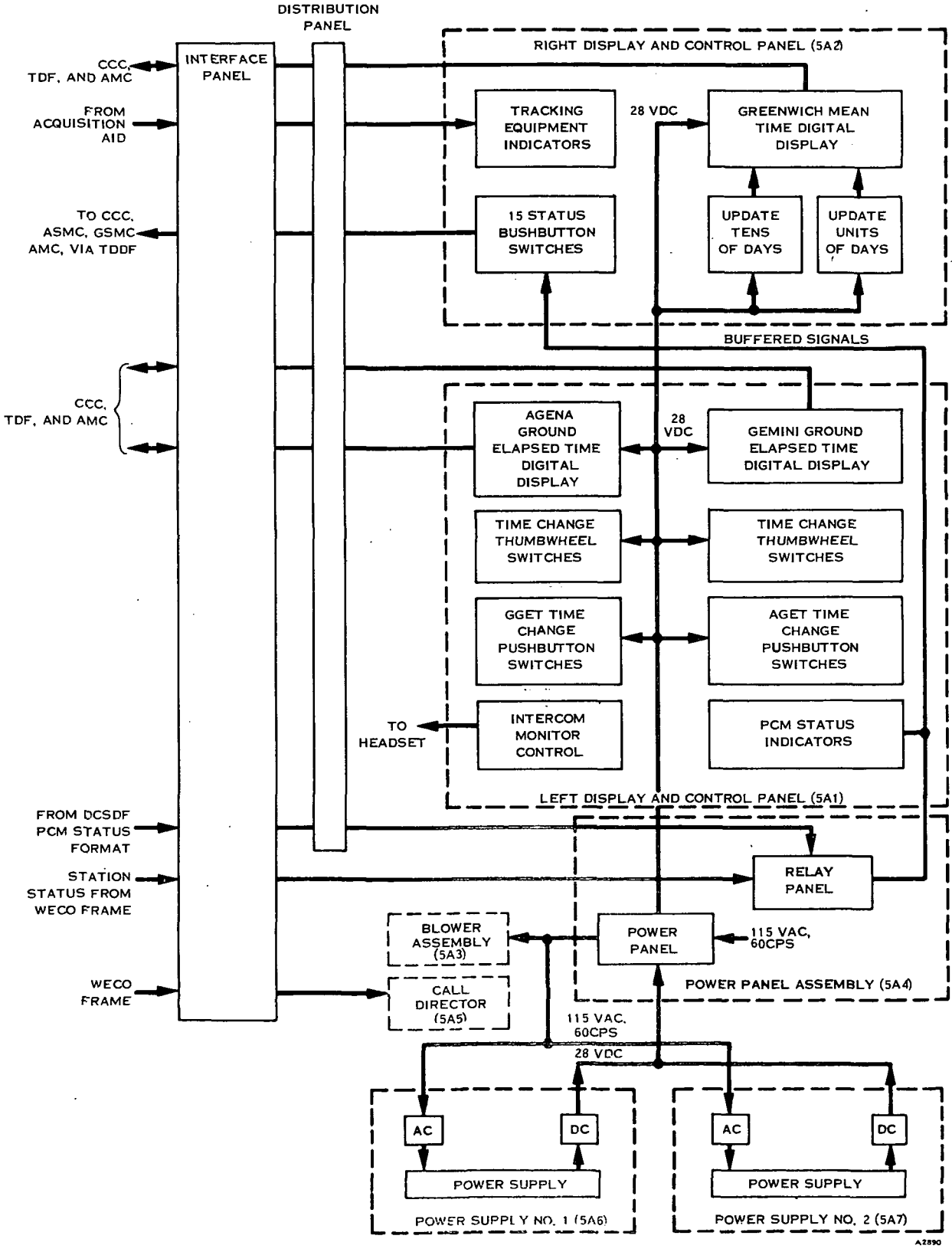

Figure 4.4-13 Maintenance and Operation Console, Block Diagram

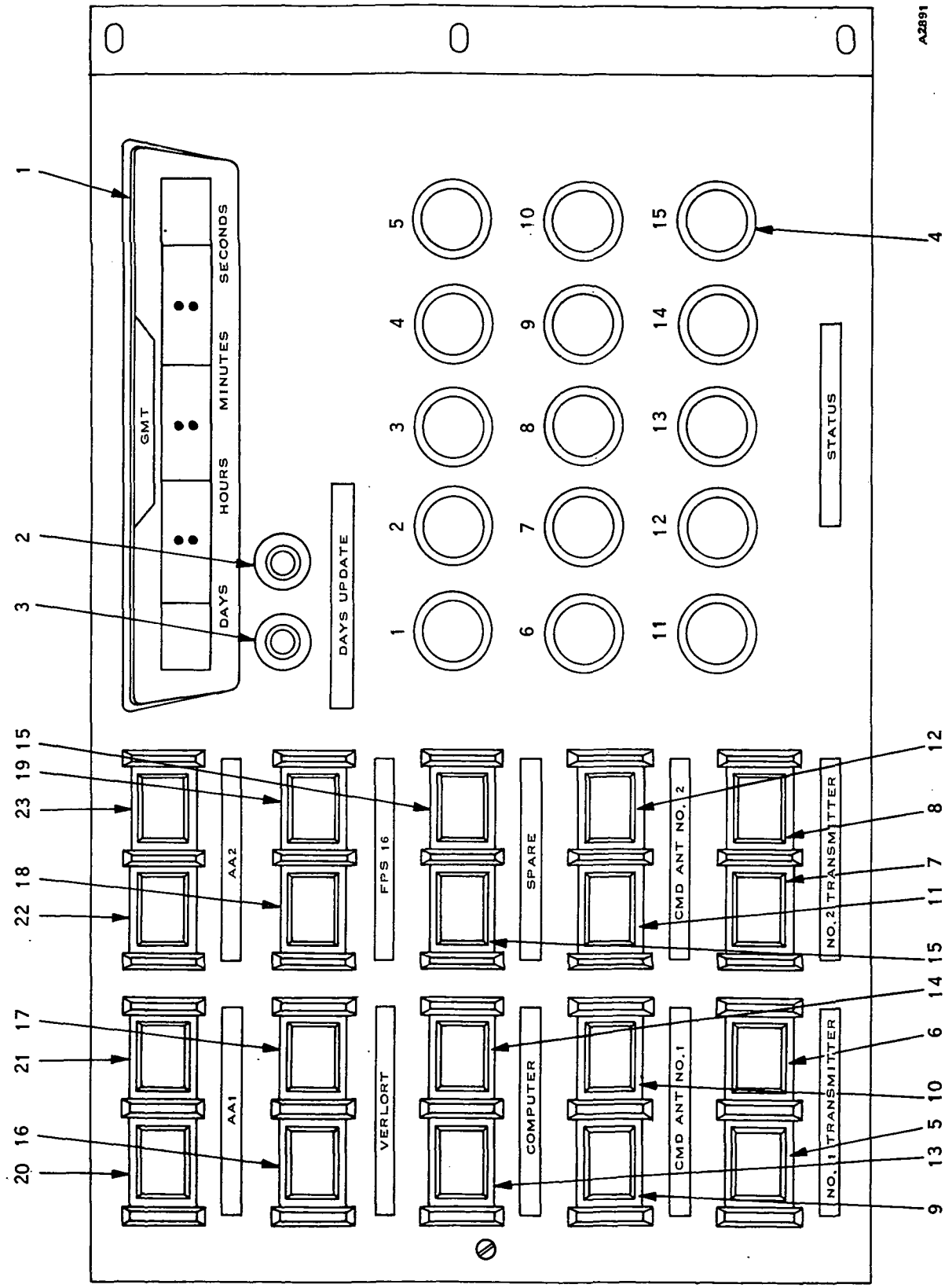

Figure 4.4-14 M&O Console, Right-Hand Display and Control Panel

TABLE 4.4-1

M&O CONSOLE RIGHT-HAND CONTROL PANEL, OPERATING CONTROLS AND INDICATORS

CONTROL OR INDICATOR	FUNCTION	FIGURE 4.4-14 INDEX
GMT Digital Display	Displays seconds, minutes, hours, and days of Greenwich Mean Time.	1
DAYS UPDATE Unit of Days Pushbutton	Used to change and update Greenwich Mean Time units of days indication.	2
DAYS UPDATE Tens of Days Pushbutton	Used to change and update Greenwich Mean Time Units of days indication.	3
STATUS Pushbuttons	Used to indicate mode of operation of on-site equipment and to relay the signals to other site consoles for display.	4
NO. 1 TRANSMITTER FRW-2 Indicator	Illumination indicates that FRW-2 of transmitter No. 1 is transmitting signals to the spacecraft.	5
NO. 1 TRANSMITTER 240-D1 Indicator	Illumination indicates that 240-D1 of transmitter No. 1 is transmitting signals to spacecraft.	6
NO. 2 TRANSMITTER FRW-2 Indicator	Illumination indicates that FRW-2 of transmitter No. 2 is transmitting signals to spacecraft.	7
NO. 2 TRANSMITTER 240-D2 Indicator	Illumination indicates that 240-D2 of transmitter No. 2 is transmitting signals to spacecraft.	8
CMD ANT No. 1 AGENA Indicator	Indicates antenna No. 1 is receiving data from Agena vehicle.	9
CMD ANT No. 1 GEMINI Indicator	Indicates antenna No. 1 is receiving data from Gemini spacecraft.	10

TABLE 4.4-1 (CONT'D)

CONTROL OR INDICATOR	FUNCTION	FIGURE 4.4-14 INDEX
CMD ANT NO. 2 AGENA Indicator	Indicates antenna No. 2 is receiving data from Agena vehicle.	11
CMD ANT No. 2 GEMINI Indicator	Indicates antenna No. 2 is receiving data from Gemini spacecraft.	12
COMPUTER AGENA Indicator	Indicates operation of the computer in the Agena mode.	13
COMPUTER GEMINI Indicator	Indicates operation of computer in Gemini mode.	14
SPARE Indicators		15
VERLORT AGENA Indicator	Indicates that verlort is tracking Agena vehicle.	16
VERLORT GEMINI Indicator	Indicates that verlort is tracking Gemini spacecraft.	17
FPS-16 AGENA Indicator	Indicates that FPS-16 is tracking Agena vehicle.	18
FPS-16 GEMINI Indicator	Indicates that FPS-16 is tracking Gemini spacecraft.	19
AA1 AGENA Indicator	Indicates that receiving system is in Agena mode, and that receiving and transmitting antennas are locked on the vehicle.	20
AA1 GEMINI Indicator	Indicates that receiving system is in Gemini mode and that receiving and transmitting antennas are locked on the spacecraft.	21
AA2 AGENA Indicator	Indicates that receiving system is in Agena mode and that receiving and transmitting antennas are locked on the vehicle.	22

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TABLE 4.4-1 (CONT'D)

CONTROL OR INDICATOR	FUNCTION	FIGURE 4.4-14 INDEX
AA2 GEMINI Indicator	Indicates that receiving system is in Gemini mode and that receiving and transmitting antennas are locked on the spacecraft.	23

b. Left-Hand Display and Control Panel. The left-hand display and control panel (Figure 4.4-15) contains pushbutton and thumbwheel switches and digital displays that provide control, selection, and monitoring of telemetry and timing data.

The two digital displays provide ground countdown and count-up for Agena Ground Elapsed Time (AGET) and Gemini Ground Elapsed Time (GGET). The 7-digit thumbwheel switches are provided for resetting the AGET and GGET digital displays. Eight pushbutton switches are provided to start, stop, clear, countup, countdown, and insert thumbwheel set corrections for each of the ground elapsed time digital displays.

Six indicators provide information on sync status and format indication for the two PCM ground stations.

Table 4.4-2 contains a list of the controls and indicators on the left-hand control panel of the M&O console by name and function.

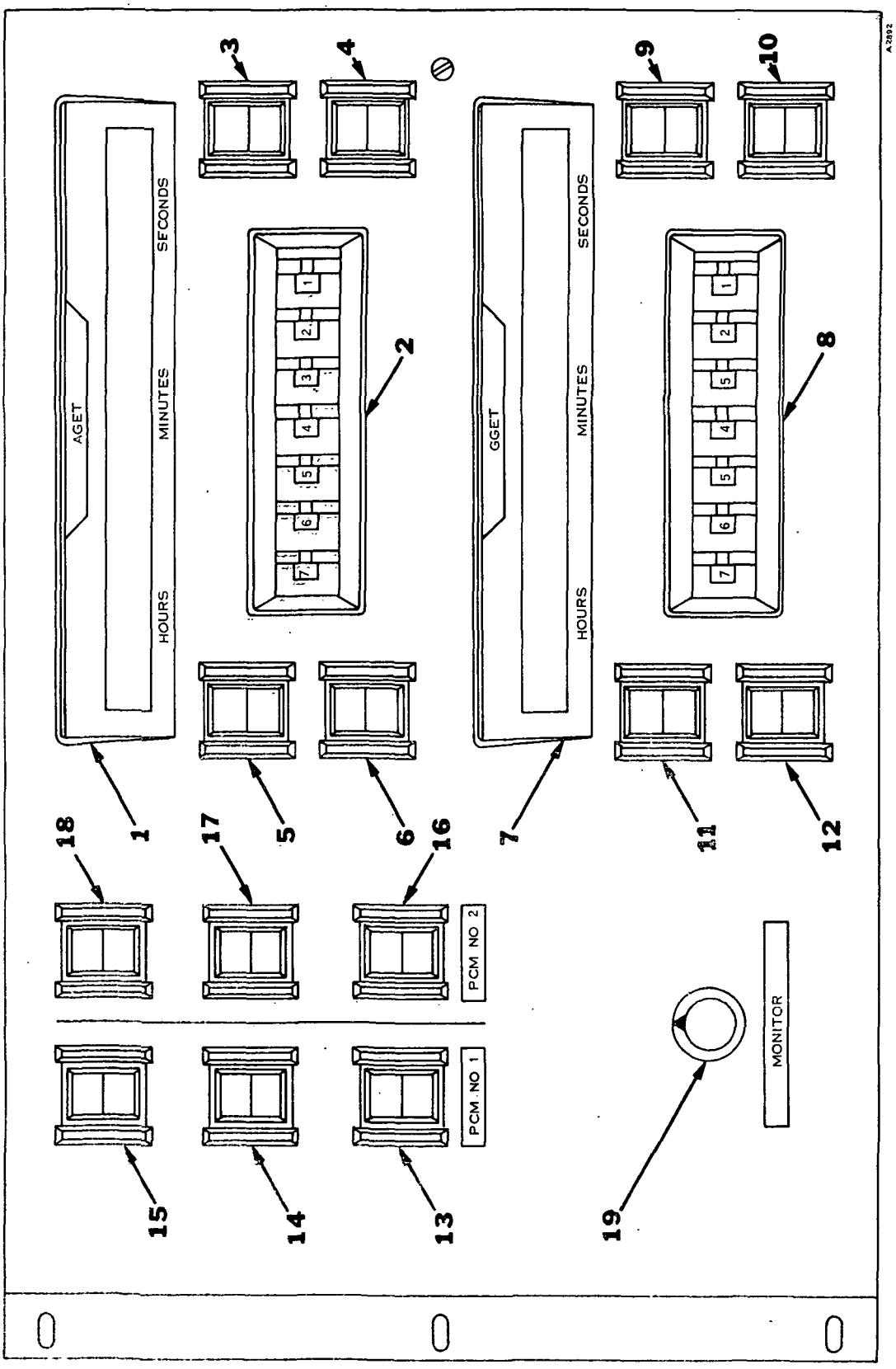

Figure 4.4-15 M&O Console, Left-Hand Display and Control Panel

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TABLE 4.4-2

M&O CONSOLE LEFT-HAND CONTROL PANEL, OPERATING CONTROLS AND INDICATORS

CONTROL OR INDICATOR	FUNCTION	FIGURE 4.4-15 INDEX
AGET Digital Display	Displays seconds, minutes, and hours of ground determined time referenced to Agena vehicle liftoff.	1
AGET Time Change Thumbwheels	Switches used to program seconds, minutes, and hours of ground elapsed time changes.	2
AGET HOLD/START Pushbutton	Starts and stops ground elapsed time displays in RDF, CCC, and M&O Console.	3
AGET UP/DOWN Pushbutton	Controls count-up and count-down direction of ground elapsed time displays in TDF, CCC and M&O Console.	4
AGET CLEAR Pushbutton	Removes time presentations from displays in TDF, CCC, and M&O Console.	5
AGET INSERT Pushbutton	When depressed, thumbwheel programmed time is inserted into clock circuits, and time is reflected on ground elapsed time displays in RDF, CCC, and M&O Console.	6
GGET Digital Display	Displays seconds, minutes, and hours of ground determined time referenced to Gemini spacecraft liftoff.	7
GGET Time Change Thumbwheels	Switches used to program seconds, minutes, and hours of ground elapsed time changes.	8
GGET HOLD/START Pushbutton	Starts and stops ground elapsed time displays in TDF, CCC, AMC, and M&O Console.	9
GGET UP/DOWN Pushbutton	Controls count-up and count-down direction of ground elapsed time displays in TDF, CCC, AMC, and M&O Console.	10

TABLE 4.4-2 (CONT'D)

CONTROL OR INDICATOR	FUNCTION	FIGURE 4.4-15 INDEX
GGET CLEAR Pushbutton	Removes time presentations from displays in TDF, CCC, AMC, and M&O Console.	11
GGET INSERT Pushbutton	When depressed, thumbwheel programmed time is inserted into clock circuits, and time is reflected on ground elapsed time displays in TDF, CCC, AMC, and M&O Console.	12
PCM NO. 1 PCM NO. 1 LOCK Indicator (Sync Status)	Indicates that PCM Station No. 1 is in sync and handling information from the spacecraft.	13
PCM NO. 1 GEMINI R/T/ GEMINI DUMP Indicator (Format Indication)	Indicates that PCM Station No. 1 is handling real time or dump data from the Gemini spacecraft.	14
PCM NO. 1 AGENA R/T/AGENA DUMP Indicator (Format Indication)	Indicates that PCM Station No. 1 is handling real time or dump data from the Agena spacecraft.	15
PCM NO. 2 PCM NO. 2 LOCK Indicator (Sync Status)	Indicates that PCM Station No. 2 is in sync and handling information from the spacecraft.	16
PCM NO. 2 GEMINI R/T/GEMINI DUMP Indicator (Format Indication)	Indicates that PCM Station No. 2 is handling real time or dump data from the Gemini spacecraft.	17
PCM NO. 2 AGENA R/T/AGENA DUMP Indicator (Format Indication)	Indicates that PCM Station No. 2 is handling real time or dump data from the Agena spacecraft.	18
MONITOR Control	Controls volume level of intercom monitor loops.	19

Gemini Systems Monitor Console (GSMC). The GSMC (Figure 4.4-16) provides facilities for display and control of telemetry, command, and communications functions for the Gemini spacecraft. Two control panels are provided for this purpose.

a. Display and Control Panel. The display and control panel (Figure 4.4-17) displays certain spacecraft-generated analog and event signals and the status of various on-site equipments. In addition, controls are provided for determining console operating modes and initiating transmission of real-time commands.

Table 4.4-3 contains a list of the controls and indicators on the GSMC display and control panel by name and function.

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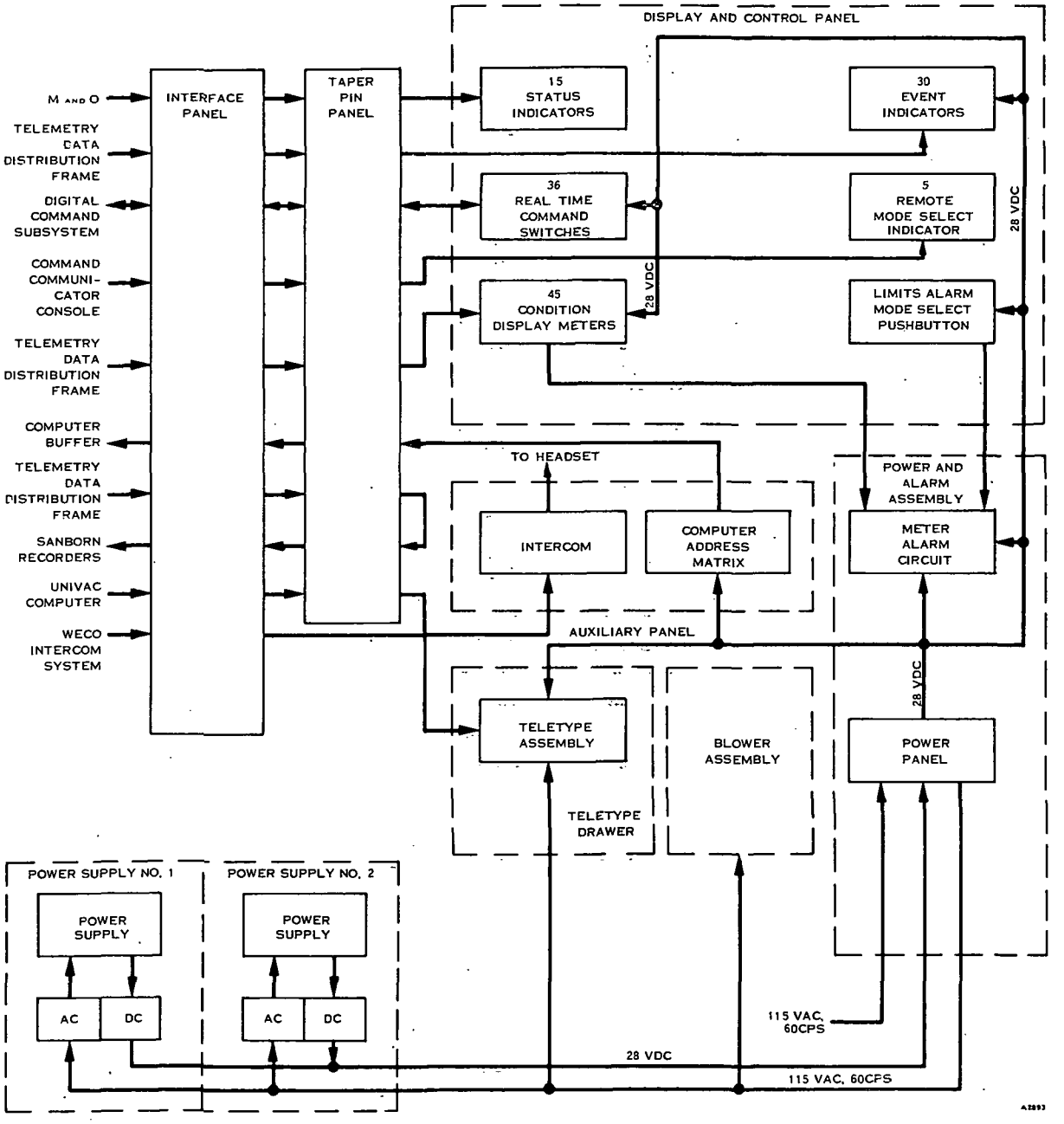

Figure 4.4-16 Gemini Systems Monitor Console (GSMC), Block Diagram

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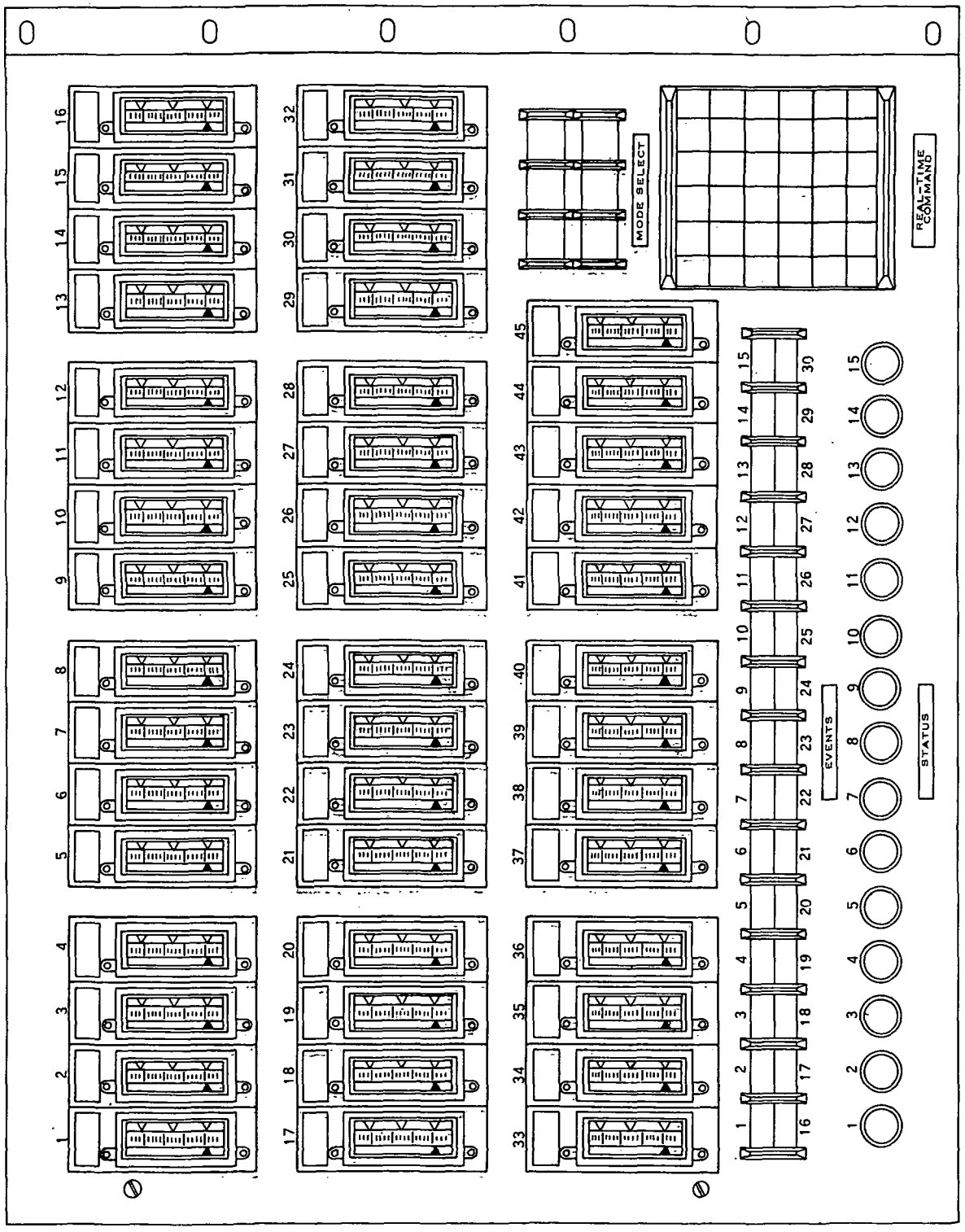

Figure 4.4-17 GSMC Display and Control Panel

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TABLE 4.4-3

GEMINI SYSTEMS MONITOR CONSOLE DISPLAY AND CONTROL PANEL, OPERATING CONTROLS AND INDICATORS

CONTROL OR INDICATOR	FUNCTION	FIGURE 4.4-17 INDEX
Condition Meters	Display measured quantities indicating physical spacecraft and astronaut conditions by means of needle deflection over a range of d-c voltages.	1
EVENT Lights	Indicate occurrence of spacecraft events ranging through mission phases of lift-off, rendezvous, docking, jettison, and re-entry.	2
STATUS Lights	Indicate mode of operation of on-site equipment.	3
MODE SELECT Pushbuttons	Controls console equipment operating modes, and displays DCS equipment modes.	4
REAL TIME COMMANDS Pushbuttons	Preconditions and initiates transmission of commands in real time to respective vehicle.	5

b. Auxiliary Panel. The auxiliary panel (Figure 4.4-18) contains intercom and teletype equipment controls and indicators and a computer address matrix for selecting individual parameters or teletype summary messages (computer summary and selected parameter call-up) from the remote site data processor for printout.

Table 4.4-4 contains a list of the controls and indicators on the GSMC auxiliary panel by name and function.

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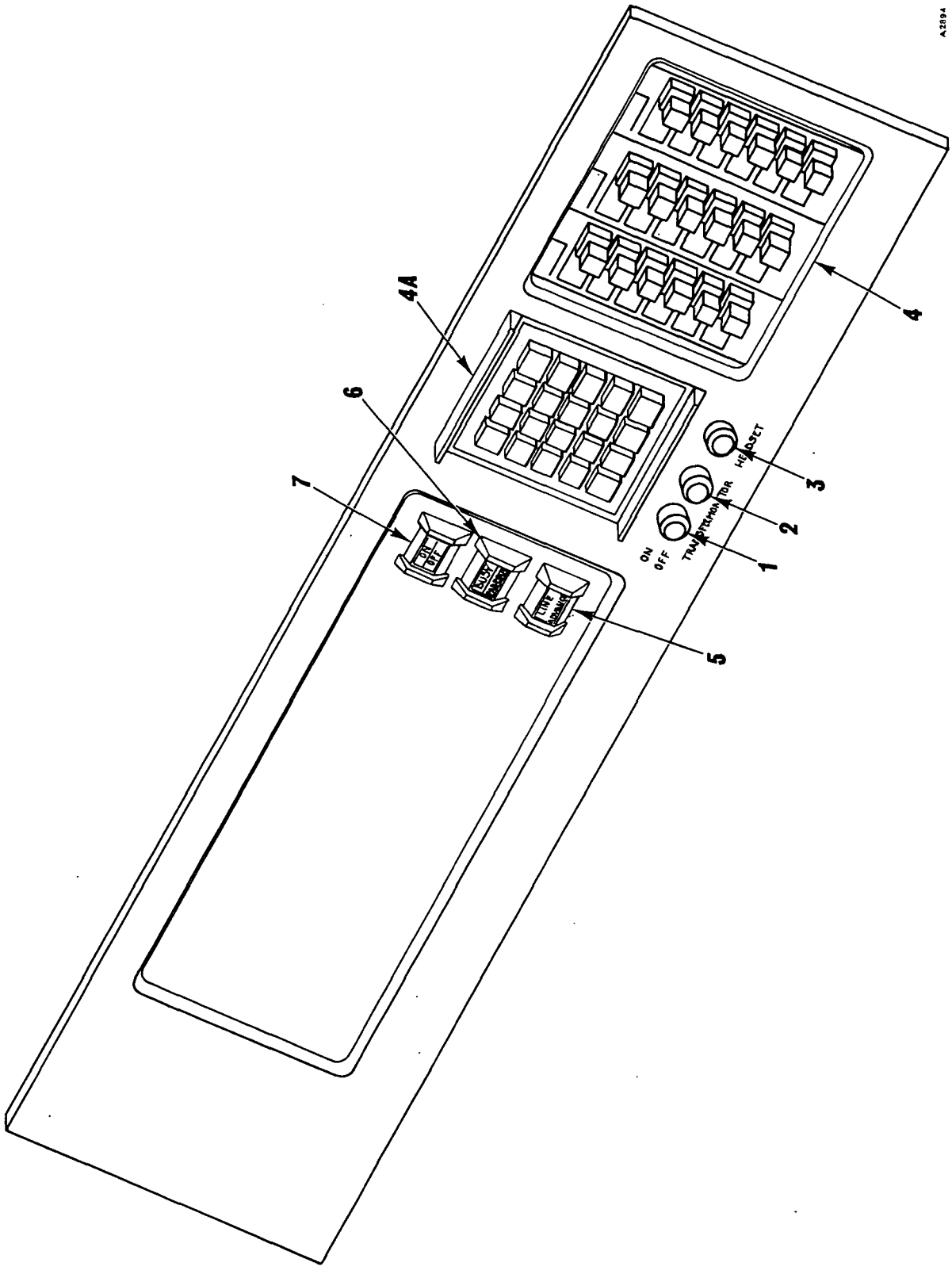

Figure 4.4-18 GSMC Auxiliary Panel

TABLE 4.4-4

GEMINI SYSTEMS MONITOR CONSOLE AUXILIARY PANEL, OPERATING CONTROLS AND INDICATORS

CONTROL OR INDICATOR	FUNCTION	FIGURE 4.4-18 INDEX
SPEAKER Volume Control and ON-OFF switch	Turns intercom loudspeaker on or off, and adjusts volume level.	1
MONITOR Control	Controls volume level of intercom monitor loops.	2
HEADSET Control	Controls volume level of intercom headsets.	3
24 Pushbutton Intercom Key Set	White keys select talk and listen intercom loops; amber keys allow selection of monitor loops.	4
COMPUTER ADDRESS Pushbutton Matrix	Selects parameters and summary messages for printout by teletype.	4A
LINE ADVANCE/PAPER OUT Pushbutton	Advances paper in teletype printer and indicates if paper supply is nearly exhausted.	5
BUSY Light Indicator	Indicates teletype is in process of printing out a message.	6
ON/OFF Pushbutton	Turns teletype printer on or off.	7

Agena Systems Monitor Console (ASMC). The ASMC provides facilities for display and control of telemetry, command, and communications for the Agena spacecraft. The ASMC is identical to the GSMC except that it is used for the Agena vehicle (refer to Paragraph 4.4.1.6.b).

Aeromed Monitor Console (AMC). The aeromed monitor console (Figure 4.4-19) provides facilities for displaying and recording biomedical and life support system parameters from the Gemini spacecraft and certain communications functions. Two display panels are provided for this purpose.

a. Display Panel. The display panel (Figure 4.4-20) contains 18 d-c meters for displaying astronaut biomedical information and certain spacecraft life support system parameters. Twenty event lights provide indications of various spacecraft events pertinent to the life support system. Two decimal displays provide GMT and GGET.

   Table 4.4-5 contains a list of the indicators on the AMC display panel by name and function.

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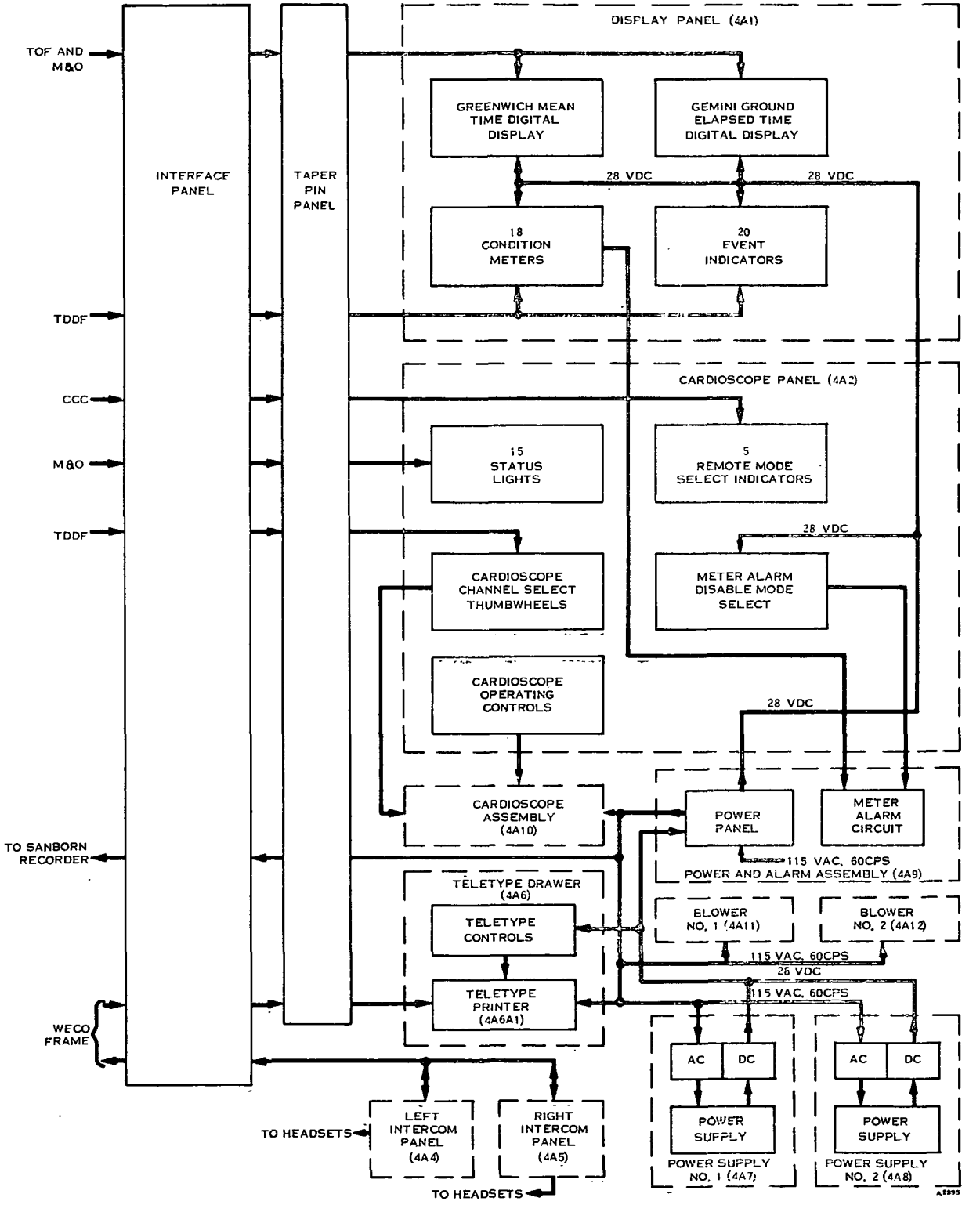

Figure 4.4-19 Aeromed Monitor Console (AMC), Block Diagram

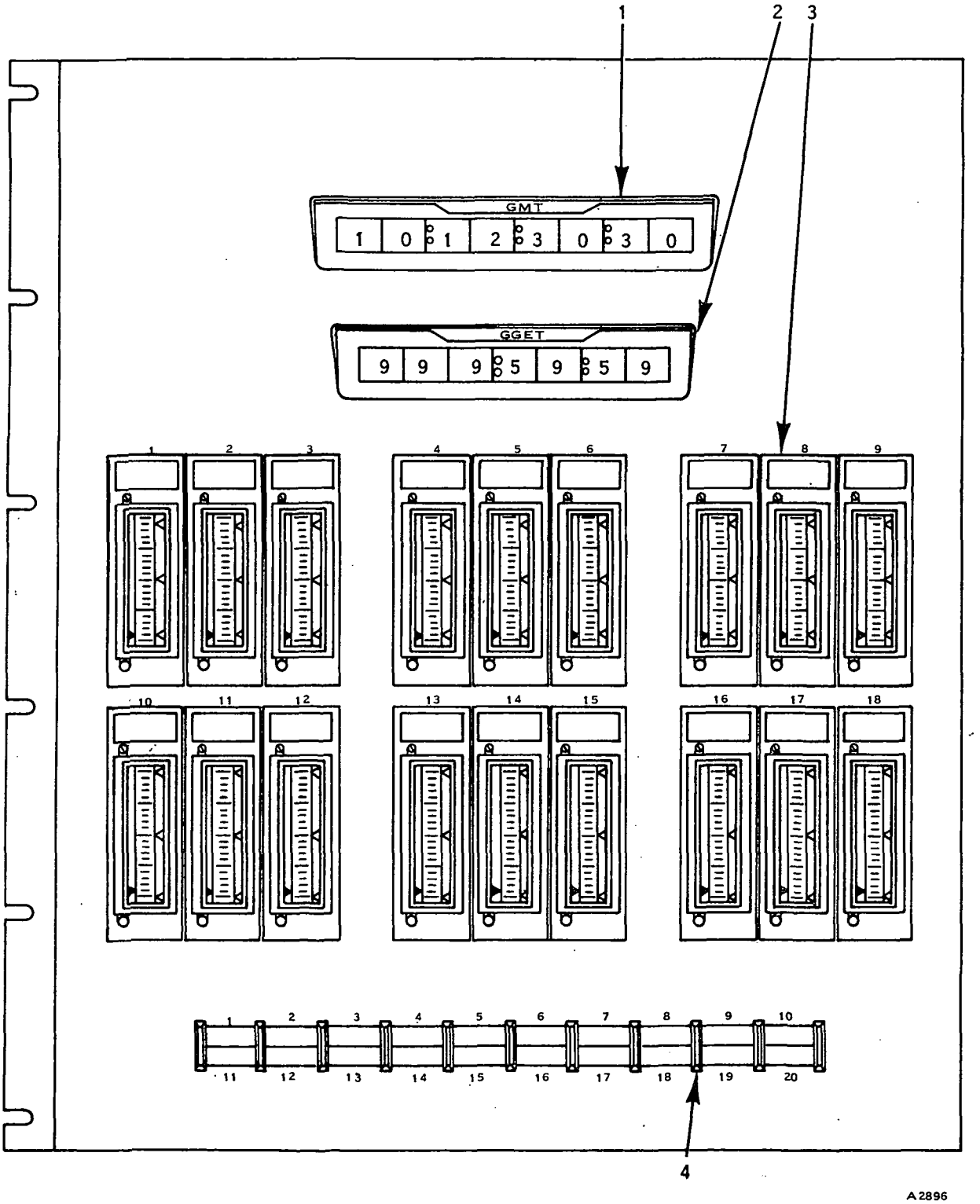

Figure 4.4-20 Aeromed Monitor Console Display Panel

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TABLE 4.4-5

AEROMEDICAL MONITOR CONSOLE DISPLAY PANEL INDICATORS

CONTROL OR INDICATOR	FUNCTION	FIGURE 4.4-20 INDEX
GMT Digital Display	Displays seconds, minutes, hours, and days of Greenwich Mean Time.	1
GGET Digital Display	Displays seconds, minutes, and hours of ground-determined time referenced to Gemini spacecraft launch time.	2
Condition Meters	Display measured quantities indicating spacecraft and astronaut physical conditions over a range of d-c voltages.	3
EVENT Lights	Indicate occurrence of spacecraft events ranging through mission phases of rendezvous, coupling, jettison, and reentry.	4

b. Cardioscope Panel. The cardioscope panel (Figure 4.4-21) contains a four-channel CRT for displaying the heart beats, as well as other biomedical parameters, of the astronauts. Status lights display station and support equipment status information. Mode select switches display the mode of operation of on-site equipment.

The information displayed on the cardioscope and certain other selectable parameters are recorded on a Sanborn recording system.

Table 4.4-6 contains a list of the controls and indicators on the AMC cardioscope panel by name and function.

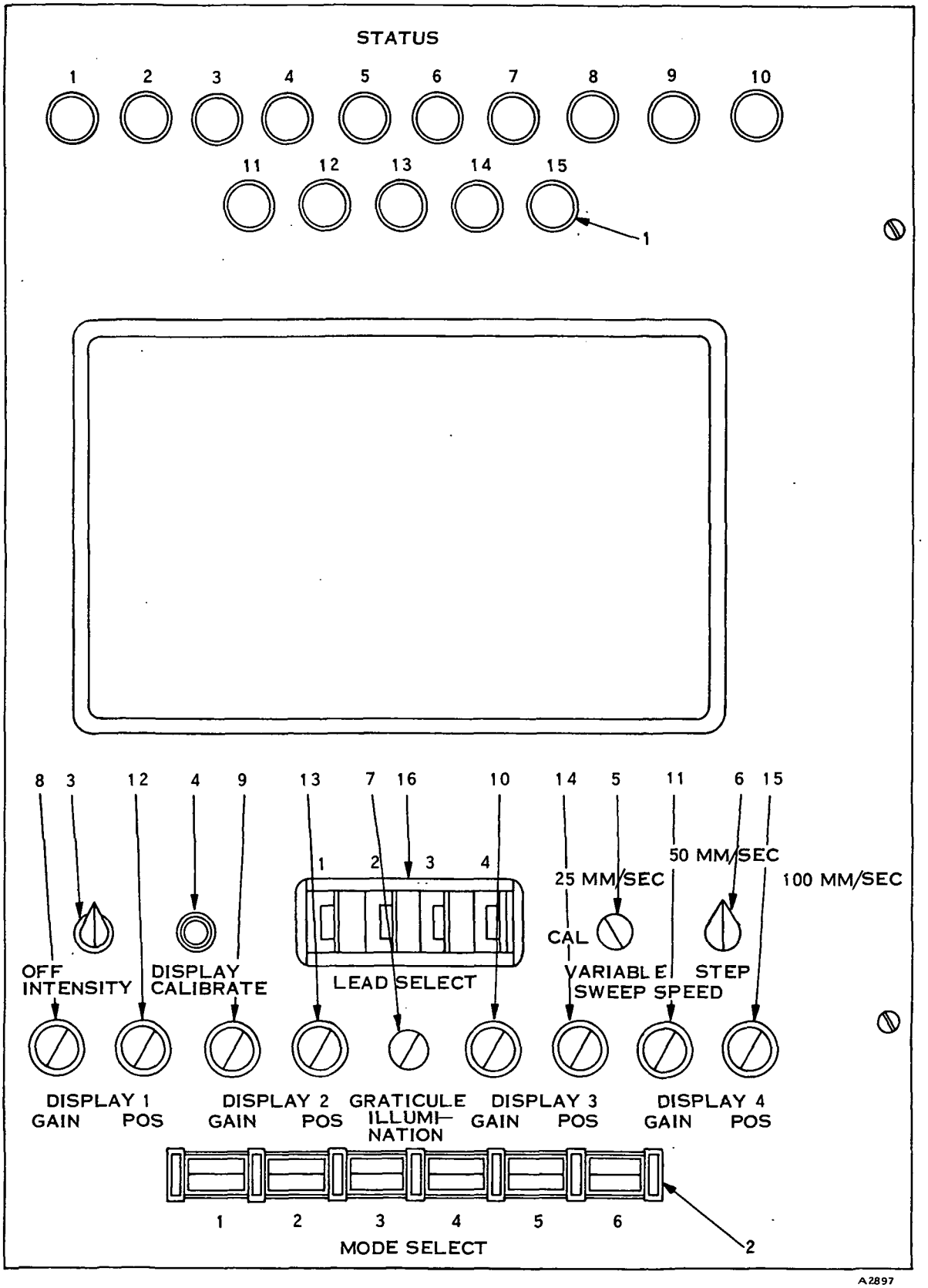

Figure 4.4-21 Aeromed Monitor Console Cardioscope Panel

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TABLE 4.4-6

AEROMEDICAL MONITOR CONSOLE CARDIOSCOPE PANEL, OPERATING CONTROLS AND INDICATORS

CONTROL OR INDICATOR	FUNCTION	FIGURE 4.4-21 INDEX
STATUS Lights	Indicate mode of operation of on-site equipment.	1
MODE SELECT Pushbuttons	Display DCS equipment modes.	2
OFF INTENSITY Control	Turns cardioscope on or off, and adjusts cardioscope trace brightness from off to maximum illumination.	3
DISPLAY CALIBRATE Pushbutton Switch	Inserts reference signal to check vertical deflection of four cardioscope traces.	4
SWEEPSPEED VARIABLE Control	Varies speed of cardioscope trace sweep from 25 to 50, 50 to 100, and 100 to 200 millimeters per second.	5
	In CAL position, each variable potentiometer is set to maximum counterclockwise position, so that sweep speed can be calibrated for 25, 50, and 100 millimeter settings.	
SWEEP SPEED STEP Switch	Adjusts light intensity on graticule from off to maximum illumination.	7
DISPLAY 1 GAIN Control	Adjusts vertical gain of trace 1 on cardioscope.	8
DISPLAY 2 GAIN Control	Adjusts vertical gain of trace 2 on cardioscope.	9
DISPLAY 3 GAIN Control	Adjusts vertical gain of trace 3 on cardioscope.	10
DISPLAY 4 GAIN Control	Adjusts vertical gain of trace 4 on cardioscope.	11
DISPLAY 1 POS Control	Adjusts vertical position of trace 1 on cardioscope.	12

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TABLE 4.4-6 (CONT'D)

CONTROL OR INDICATOR	FUNCTION	FIGURE 4.4-21 INDEX
DISPLAY 2 POS Control	Adjusts vertical position of trace 2 on cardioscope.	13
DISPLAY 3 POS Control	Adjusts vertical position of trace 3 on cardioscope.	14
DISPLAY 4 POS Control	Adjusts vertical position of trace 4 on cardioscope.	15
LEAD SELECT Thumbwheel Switches	Selects analog input to be displayed by one of the four cardioscope channels.	16

Command Communicator Console (CCC). The CCC (Figure 4.4-22) consists of data display and command facilities for time, spacecraft dynamics, event, status, command, and communications functions. This is accomplished through the use of two control and display panels;

a. Display and Control Panel. The Display and Control Panel (Figure 4.4-23) provides displays for spacecraft-generated time, analog parameters, events, equipment status, and the spacecraft Inertial Guidance System (IGS) computer mode. With the exception of spacecraft- and ground-generated time, all display inputs to the CCC display and control panel come from the Telemetry Data Distribution Frame (TDDF) and spacecraft-generated time (AET, GET, and T_r) is input from the spacecraft clock converter in telemetry output buffer No. 1. The timing inputs are displayed by nine decimal displays.

The Display and Control Panel also provides controls for set-up of the timing displays, selection of on-site equipment operating modes, and initiation of real-time commands.

Table 4.4-7 contains a list of the controls and indicators on the display and control panel of the CCC.

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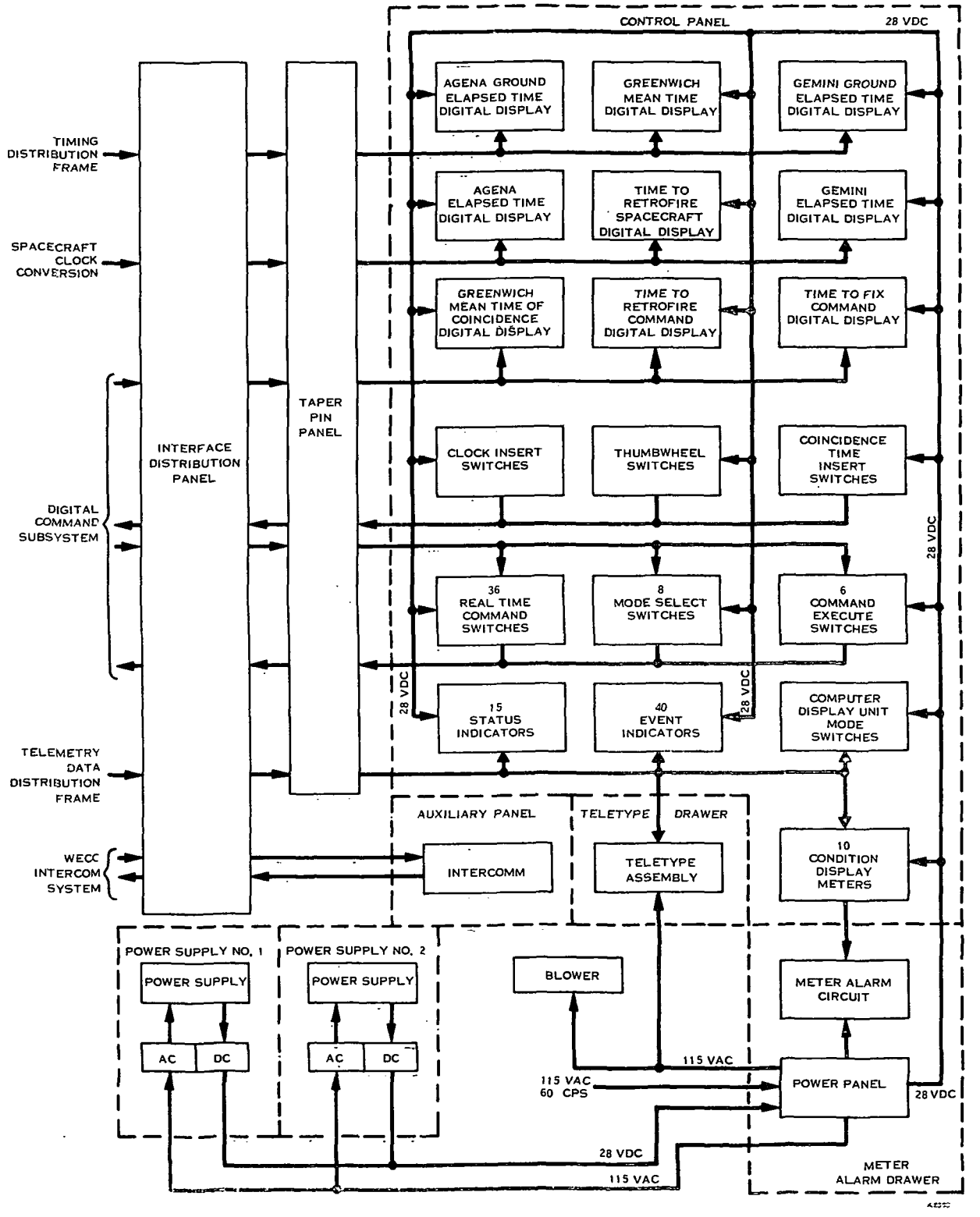

Figure 4.4-22 Command Communicator Console, Block Diagram

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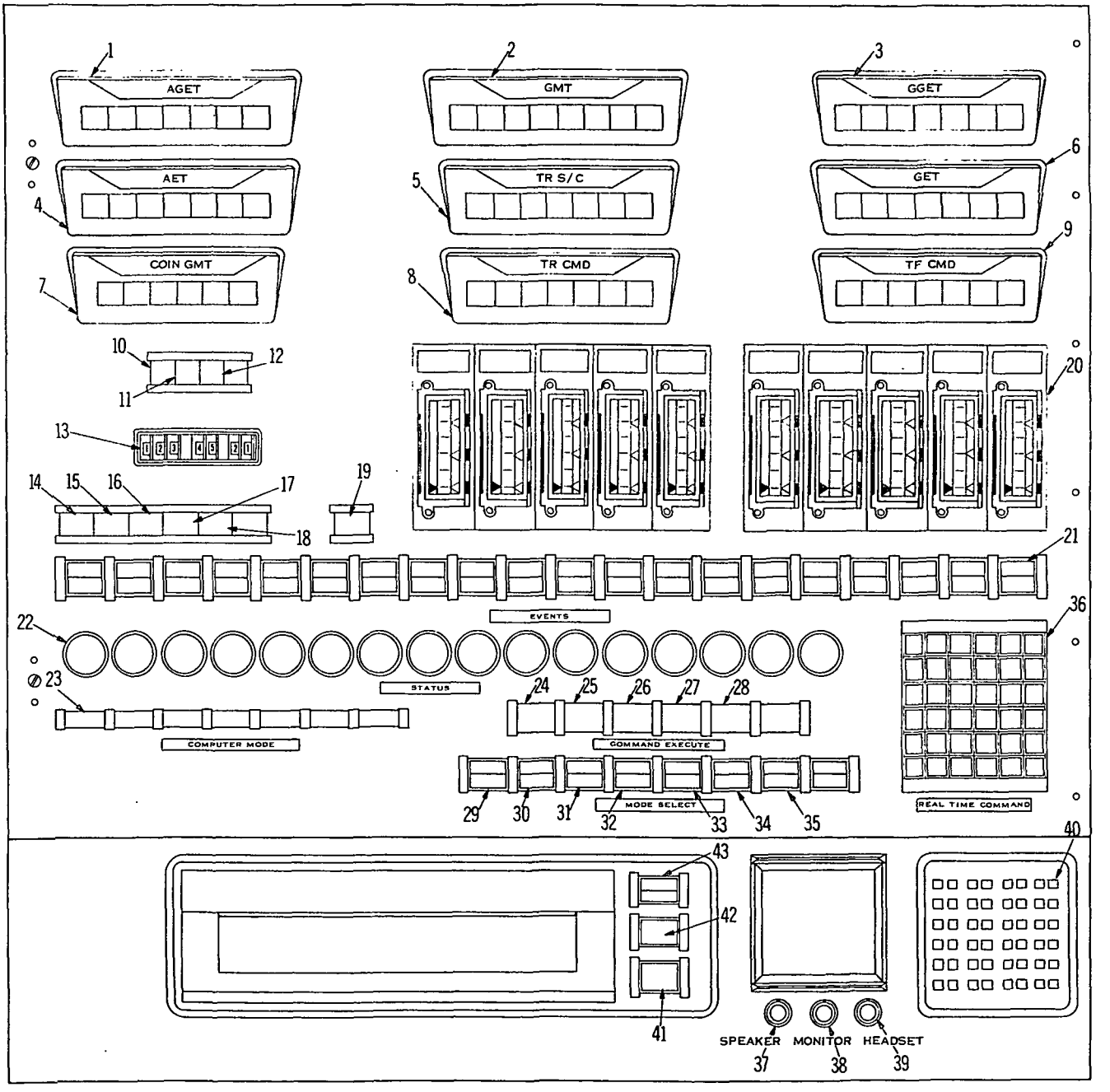

Figure 4.4-23 Command Communicator Console Display and Control Panel

TABLE 4.4-7

COMMAND COMMUNICATOR CONSOLE DISPLAY AND CONTROL PANEL, OPERATING CONTROLS AND INDICATORS

CONTROL OR INDICATOR	FUNCTION	FIGURE 4.4-23 INDEX
AGET Digital Display	Displays seconds, minutes, and hours of ground-determined time referenced to Agena vehicle lift-off.	1
GMT Digital Display	Displays seconds, minutes, hours, and days of Greenwich Mean Time.	2
GGET Digital Display	Displays seconds, minutes, and hours of ground-determined time referenced to Gemini spacecraft lift-off.	3
AET Digital Display	Displays seconds, minutes and hours of elapsed time from lift-off as recorded in the Agena vehicle.	4
TR S/C Digital Display	Displays seconds, minutes, and hours of time to retrofire as displayed in the Gemini spacecraft.	5
GET Digital Display	Displays seconds, minutes, and hours of elapsed time from lift-off as recorded in the Gemini spacecraft.	6
COIN GMT Digital Display	Displays seconds, minutes, and hours of preset coincidence time relative to fix, or time of execution.	7
TR CMD Digital Display	Displays seconds, minutes, and hours of pre-determined ground-commanded time to retrofire.	8
TF CMD Digital Display	Displays seconds, minutes, and hours of pre-determined ground-commanded time to fix.	9
TR Coincidence Pushbutton	Inserts programmed coincidence time to retrofire into DCS for transmission to the spacecraft.	10

TABLE 4.4-7 (CONT'D)

CONTROL OR INDICATOR	FUNCTION	FIGURE 4.4-23 INDEX
TF Coincidence Pushbutton	Inserts programmed coincidence time to fix into DCS for transmission to the spacecraft.	11
TX Coincidence Pushbutton	Inserts programmed coincidence time of execution into DCS for transmission to spacecraft.	12
Clock Insert Thumbwheels	Programs seconds, minutes, and hours of pre-determined time to retrofire, time to fix, time of execution and coincidence time.	13
TR Clock Insert Pushbutton	Selects TR CMD digital display and associated circuitry for insertion of a pre-determined time to retrofire.	14
TF Clock Insert Pushbutton	Selects TF CMD digital display and associated circuitry for insertion of a pre-determined time to retrofire.	15
TX Clock Insert Pushbutton	Selects time of execution digital display (located on the DCS console) and associated circuitry for insertion of a pre-determined time of command execution.	16
COIN TIMER Clock Insert Pushbutton	Selects coincidence circuitry and associated COIN GMT digital display for insertion of a programmed coincidence time to retrofire, time to fix, or time of execution.	17
MAN START Clock Insert Pushbutton	Manually starts TR CMD, TF CMD, and TX digital displays and associated circuitry counting.	18
INSERT Pushbutton	Inserts programmed times into timing circuits.	19

TABLE 4.4-7 (CONT'D)

CONTROL OR INDICATOR	FUNCTION	FIGURE 4.4-23 INDEX
Condition Meters	Display measured quantities indicating physical spacecraft and astronaut conditions by means of needle deflection over a range of d-c voltages.	20
EVENT Lights	Indicate occurrence of spacecraft events ranging through mission phases of lift-off-rendezvous, coupling, jettison, and reentry.	21
STATUS Lights	Indicate mode of operation of on-site equipment.	22
COMPUTER MODE Lights	Indicate mode of operation of the spacecraft on-board computer.	23
COMMAND EXECUTE Pushbuttons	Initiates transmission of programmed functions.	
TR Pushbutton	Initiates transmission of time-to-retrofire signals (stored in the DCS) to spacecraft.	24
TF Pushbutton	Initiates transmission of time-to-fix signals (stored in the DCS) to spacecraft.	25
TX Pushbutton	Initiates transmission of time-of-execution signals (stored in the DCS) to spacecraft.	26
GEMINI LOAD Pushbutton	Initiates transmission of Gemini priority real-time commands (stored in the DCS).	27
V/M LOAD	Initiates transmission of Agena priority real-time commands (stored in the DCS).	

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TABLE 4.4-7 (CONT'D)

CONTROL OR INDICATOR	FUNCTION	FIGURE 4.4-23 INDEX
MODE SELECT Pushbuttons	Controls on-site equipment operating modes.	
SET-UP/CMD Alternate Action Pushbutton	SET-UP - Preconditions real-time commands prior to transmission. CMD - Allows priority or standard real-time commands to be transmitted.	29
AUTO/MANUAL Alternate Action Pushbutton	AUTO - Initiates automatic searching of the DCS for pre-conditioned priority real-time commands. MANUAL - Permits discrete initiation of standard real-time commands for transmission to spacecraft.	30
FC/M&O	FC - Permits CCC operator to control all command functions which relate to the Digital Command Subsystem. M&O - Permits transfer of control of all command functions relating the Digital Command Subsystem to the DCS Console.	31
LIMITS/ALARM Alternate Action Pushbutton	Shuts off audible alarm associated with an out-of-tolerance condition displayed by any of the 10 meters for test purposes.	32
LIGHT/TEST Alternate Action Pushbutton	Energizes or de-energizes meter out-of-tolerance indicators for test purposes.	33

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TABLE 4.4-7 (CONT'D)

CONTROL OR INDICATOR	FUNCTION	FIGURE 4.4-23 INDEX
STATUS/HOLD Alternate Action Pushbutton	Holds transmission and acquisition indications of real-time commands after loss of telemetry.	34
PRIORITY/CLEAR Alternate Action Pushbutton		35
REAL TIME COMMANDS Pushbuttons	Preconditions and initiates transmission of commands in real time to Gemini and Agena vehicles.	36

b. Auxiliary Panel. The auxiliary panel (Figure 4.4-18) contains inter-communications equipment controls and does not have the capability of calling up telemetry data from the computer.

4.4.1.8 Remote Site Data Processor

The Remote Site Data Processor (RSDP) is a UNIVAC 1218 computer that accepts data from TOB No. 2 and assembles the data into a 2.0K bps format for transmission to the MSCC via a 201A modem. In addition, the RSDP outputs telemetry parameters to the Gemini and Agena Systems Monitor consoles in accordance with the instructions received from the CAM logic section of the computer buffer in TOB No. 2. The RSDP also outputs teletype summary data to the communications terminal facility, which transmits teletype summary messages to the MSCC.

The data is input to the RSDP according to the computer input request pulses generated in the PCM logic section of the computer buffer. Following the computer interrupt input, the data input to the RSDP is placed in memory locations according to the stored program. The RSDP then extracts the data from memory and assembles it into a 2.0K bps format for parallel transfer to a parallel-to-serial converter, where the data is serialized and fed through the NAVCOR to the 201A modems.

Gemini 2.0K bps Formats. There are two Gemini 2.0K bps formats; one for real-time data and one for dump data. These two formats, however, are identical with one exception; the dump format contains prime subframe data, while the main frame word slots contain fill data (11110000). The real-time format contains both main frame and prime subframe data. All blank spaces in either format contain fill data.

Figure 4.4-24 illustrates the Gemini real-time/dump 2.0K bps format output from the RSDP. Each frame of data contains 500 8-bit word slots and occurs every two seconds. The first three words in the format are synchronization words having the following bit configuration: 01001100

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NOTES (UNLESS OTHERWISE SPECIFIED):

1. ALPHANUMERIC CHARACTERS DENOTE PARAMETER NUMBER AS CONTAINED IN THE GEMINI PARAMETER LIST (REFER TO PHO-1Z4000)

GEMINI MAIN FRAME DATA

SYNC S1 1	SYNC S2 2	SYNC S3 3	ID (MESSAGE LABEL) 4	STATUS WORD 5	LA01 ✱ 6	7	AA01 ●● 8	9	KA01 ⍦ 10	11	LA01 ✱ 12	13	EA01 ⊖ 14	X1 15	16	17	LA01 ✱ 18	19	20	21	22	23	LA01 ✱ 24	25
26	27	BD01 O 28	BD02 O 29	BE01 O 30	LA01 ✱ 31	X2 32	AA01 ●● 33	BE02 O 34	KA02 ⍦ 35	BF01 O 36	LA01 ✱ 37	BF05 O 38	EA02 ⊖ 39	BH01 O 40	BH02 O 41	42	LA01 ✱ 43	44	CD03 O 45	46	X3 47	48	LA01 ✱ 49	50
51	52	CH01 O 53	CH02 O 54	CJ15 O 55	LA01 ✱ 56	CK05 O 57	AA01 ●● 58	GB01 O 59	KA03 ⍦ 60	GB02 O 61	LA01 ✱ 62	X4 63	EA03 ⊖ 64	65	66	67	LA01 ✱ 68	AA03 69	AA03 70	AA03 71	72	73	LA01 ✱ 74	75
76	77	78	X5 79	80	LA01 ✱ 81	82	AA01 ●● 83	84	KB02 ⍦ 85	86	LA01 ✱ 87	88	89	90	91	92	LA01 ✱ 93	94	X6 95	96	97	98	LA01 ✱ 99	100
AG06 △ 101	HH06 △ 102	AA02 103	AA02 104	AA02 105	LA01 ✱ 106	107	AA01 ●● 108	109	110	X7 111	LA01 ✱ 112	113	FA01 ● 114	BG01 △ 115	BG02 △ 116	BG03 △ 117	LA01 ✱ 118	119	120	121	BG04 △ 122	CA01 △ 123	LA01 ✱ 124	CA02 △ 125
CA03 △ 126	X8 127	128	129	130	LA01 ✱ 131	CA04 △ 132	AA01 ●● 133	CB01 △ 134	135	CB02 △ 136	LA01 ✱ 137	CB03 △ 138	FA02 ● 139	CB07 △ 140	CC01 △ 141	X9 142	LA01 ✱ 143	DH01 144	DH01 145	DH01 146	CC02 △ 147	CC03 △ 148	LA01 ✱ 149	CC04 △ 150
CC06 △ 151	CH04 △ 152	DH02 153	DH02 154	DH02 155	LA01 ✱ 156	CH05 △ 157	AA01 ●● 158	X10 159	160	CJ01 △ 161	LA01 ✱ 162	CJ02 △ 163	FA03 ● 164	CJ03 △ 165	CJ04 △ 166	CK01 △ 167	LA01 ✱ 168	DH03 169	DH03 170	DH03 171	CK02 △ 172	CK03 △ 173	LA01 ✱ 174	X11 175
CK04 △ 176	CL02 △ 177	DH07 178	DH07 179	DH07 180	LA01 ✱ 181	CL03 △ 182	AA01 ●● 183	CL05 △ 184	185	DA01 △ 186	LA01 ✱ 187	DA02 △ 188	DA03 △ 189	DB03 △ 190	X12 191	DB06 △ 192	LA01 ✱ 193	DH08 194	DH08 195	DH08 196	DD01 △ 197	DD02 △ 198	LA01 ✱ 199	DD03 △ 200
DE01 △ 201	DE02 △ 202	DH09 203	DH09 204	DH09 205	LA01 ✱ 206	X13 207	AA01 ●● 208	DE05 △ 209	DG01 △ 210	DG02 △ 211	LA01 ✱ 212	DG03 △ 213	EB01 △ 214	EB02 △ 215	EC01 △ 216	EC02 △ 217	LA01 ✱ 218	DH13 219	DH13 220	DH13 221	EC03 △ 222	X14 223	LA01 ✱ 224	EC04 △ 225
EC05 △ 226	227	DH14 228	DH14 229	DH14 230	LA01 ✱ 231	232	AA01 ●● 233	234	235	236	LA01 ✱ 237	238	X15 239	240	241	242	LA01 ✱ 243	DH04 244	DH04 245	DH04 246	247	248	LA01 ✱ 249	250
251	252	253	254	255	LA01 ✱ 256	257	AA01 ●● 258	259	KA01 ⍦ 260	261	LA01 ✱ 262	263	EA01 ⊖ 264	X1 265	266	267	LA01 ✱ 268	269	270	271	272	273	LA01 ✱ 274	275
GC02 O 276	GC03 O 277	GC04 O 278	HA02 O 279	HB02 O 280	LA01 ✱ 281	X2 282	AA01 ●● 283	HC05 O 284	KA02 ⍦ 285	HC06 O 286	LA01 ✱ 287	288	EA02 ⊖ 289	290	291	LA05 O 292	LA01 ✱ 293	LB04 O 294	LD01 O 295	LE01 O 296	X3 297	MA38 O 298	LA01 ✱ 299	MB02 O 300
MC02 O 301	PB05 O 302	PC03 O 303	PD04 O 304	PD06 O 305	LA01 ✱ 306	PD08 O 307	AA01 ●● 308	PE11 O 309	KA03 ⍦ 310	PE12 O 311	LA01 ✱ 312	X4 313	EA03 ⊖ 314	CM01 O 315	CM02 O 316	CM03 O 317	LA01 ✱ 318	AA03 319	AA03 320	AA03 321	CM04 O 322	323	LA01 ✱ 324	325
326	327	328	X5 329	330	LA01 ✱ 331	332	AA01 ●● 333	334	KB02 ⍦ 335	336	LA01 ✱ 337	338	339	340	341	342	LA01 ✱ 343	344	X6 345	346	347	348	LA01 ✱ 349	350
GC01 △ 351	GC05 △ 352	DH05 353	DH05 354	DH05 355	LA01 ✱ 356	GD01 △ 357	AA01 ●● 358	HC01 △ 359	360	X7 361	LA01 ✱ 362	HC02 △ 363	FA01 ● 364	HC03 △ 365	HC04 △ 366	HD01 △ 367	LA01 ✱ 368	DH06 369	DH06 370	DH06 371	HH01 △ 372	373	LA01 ✱ 374	HH07 △ 375
376	X8 377	DH11 378	DH11 379	DH11 380	LA01 ✱ 381	382	AA01 ●● 383	384	385	386	LA01 ✱ 387	388	FA02 ● 389	390	391	X9 392	LA01 ✱ 393	DH10 394	DH10 395	DH10 396	397	LA02 △ 398	LA01 ✱ 399	LA03 △ 400
LA04 △ 401	LA06 △ 402	DH12 403	DH12 404	DH12 405	LA01 ✱ 406	LA07 △ 407	AA01 ●● 408	X10 409	410	LA08 △ 411	LA01 ✱ 412	LA09 △ 413	FA03 ● 414	LB01 △ 415	LB03 △ 416	LE03 △ 417	LA01 ✱ 418	DH15 419	DH15 420	DH15 421	LE04 △ 422	MA17 △ 423	LA01 ✱ 424	X11 425
MA21 △ 426	MA24 △ 427	DH16 428	DH16 429	DH16 430	LA01 ✱ 431	MA37 △ 432	AA01 ●● 433	MA95 △ 434	435	MB03 △ 436	LA01 ✱ 437	MC01 △ 438	NA06 △ 439	NB06 △ 440	X12 441	QB04 △ 442	LA01 ✱ 443	DH17 444	DH17 445	DH17 446	447	448	LA01 ✱ 449	450
451	452	DH18 453	DH18 454	DH18 455	LA01 ✱ 456	X13 457	AA01 ●● 458	459	460	461	LA01 ✱ 462	463	464	465	466	467	LA01 ✱ 468	DH19 469	DH19 470	DH19 471	472	X14 473	LA01 ✱ 474	475
476	477	DH20 478	DH20 479	DH20 480	LA01 ✱ 481	482	AA01 ●● 483	484	485	486	LA01 ✱ 487	488	X15 489	490	491	492	LA01 ✱ 493	DH21 494	DH21 495	DH21 496	497	498	LA01 ✱ 499	500

T+1 SEC

T+2 SEC

LEGEND

△-1 OF 112 ANALOG PARAMETERS
O-1 OF 48 ANALOG PARAMETERS
⊖-1 OF 3 ANALOG PARAMETERS
●-1 OF 3 ANALOG PARAMETERS
⍦-1 OF 8 ANALOG PARAMETERS
✱-MAP (LA01)
●●-TIME SINCE LIFT-OFF
X - BI-LEVEL PARAMETERS (1 THROUGH 15)
▬ - 24-BIT DIGITAL PARAMETER
STATUS WORD-USED BY BUFFER FORMATTER
ID-RTCC MESSAGE LABEL
THIS FORMAT APPLICABLE TO NS-1 AND ALSO APPLICABLE TO GT-3 UNDER PRESENT REQUIREMENTS.
S1 01001100
S2 11010111
S3 10000010

Figure 4.4-24 Gemini Real-Time/Dump 2.0K bps Format

for the first word; 11010111 for the second word; and 10000010 for the third word. The fourth word is the message label that has the following bit configuration:

Bit No.	Function
1	Last Frame Indicator (LFI): this bit is set to a "one" when transmission of telemetry data is terminated.
2	Playback indicator: this bit is set to a "one" to indicate that current data is ground playback data or airborne dump data.
3-4	Source station: these two bits are set to 00 to indicate that data is from the South Texas Tracking Station.
5-7	Frame Identification: these three bits are set to 001, respectively, to indicate that data is Gemini live, tape playback, or dump data; to 010 to indicate that data is Agena live or tape playback data; to 101 to indicate that data is Agena dump data; and to 110, respectively, to indicate that data is Agena subframe "B" data.
8	Parity; even parity on preceeding bits.

The fifth word is the status word that indicates whether data being transmitted is live, static, or fill data. The first three bits of the status word are always zeroes. The fourth and fifth bits are Agena indicators; 11 indicates live data, 10 indicates static data, 01 indicates fill data, and 00 is not used. The sixth bit is always a zero. The seventh and eighth bits are Gemini indicators; 11 indicates live data, 10 indicates static data, 01 indicates fill data, and 00 is not used.

Words No. 6 through No. 500 are data words containing telemetry parameters transmitted from the spacecraft. The alphanumeric characters in each block of Figure 4.4-24 represent the sequence number of the particular parameter appearing in each word slot. (Refer to Appendix A.1.)

Agena 2.0K bps Formats. The Agena formats are similar to the Gemini formats inasmuch as both formats have 500 eight-bit words per

frame that occur every two seconds. A detailed description of the Agena formats will be supplied in a later revision.

4.4.1.9 Communications Terminal Facility

The Communications Terminal Facility (CTF) contains High Speed Data (HSD) equipment and low speed data (teletype) equipment that provide the interface between the RSDP and the MSCC.

High Speed Data Equipment. The HSD equipment (Figure 4.4-25) consists of two parallel-to-serial converters, a NAVCOR unit, and two 201A data modems. Each parallel-to-serial converter accepts data in parallel form from an output channel of the RSDP. The data is converted to serial form and fed to the NAVCOR and the 201A modem.

The data input to the modem is used to phase-modulate a carrier that is output to the MSCC. The output of the modem is also fed back into the modem receiver where it is demodulated and fed to the NAVCOR. A complete description of the 201A data modem is contained in Appendix B.4.

The NAVCOR compares the output of the parallel-to-serial converter with the output of the 201A modem. If the two outputs do not compare, a relay closure is provided to an alarm system in the CRF.

Low Speed Data Equipment. The low speed data equipment (Figure 4.4-26) consists of a teletypewriter adapter and an ASR-28 teletypewriter. The teletypewriter adapter provides the interface between the RSDP and the communications line and between the RSDP and the ASR-28 teletypewriter. The ASR-28 teletypewriter is in parallel with the transmission line and is used for monitoring output data and to manually output messages.

The teletypewriter adapter converts the parallel data output from the RSDP to serial form for transmission to the MSCC. The adapter also automatically adds the start-of-message characters, start-of-frame characters, synchronization characters, and end-of-message characters.

(To be supplied.)

Figure 4.4-25 High-Speed Data Equipment

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(To be supplied.)

Figure 4.4-26 Low-Speed Data Equipment

The output format for the adapter is shown in Figure 4.4-27. The start of message consists of the following fixed sequence of characters: two J's (indicating that the message contains digital data), one letter symbol, one carriage-return symbol, one line-feed symbol, and one letter symbol.

The start of frame within the telemetry teletype summary message consists of one line-feed symbol and two figure symbols. The start-of-message and start-of-frame symbols are followed by a frame description as follows:

a. Kind of Data. One character identifying type of data contained in message (No. 5 indicates telemetry data)

b. Station Identity. Two characters identifying source of message; CNV = 31, BDA = 02, RKV = 03, CYI = 04, CSQ = 07, HAW = 12, GYM = 14, TEX = 16, and CRO = 08.

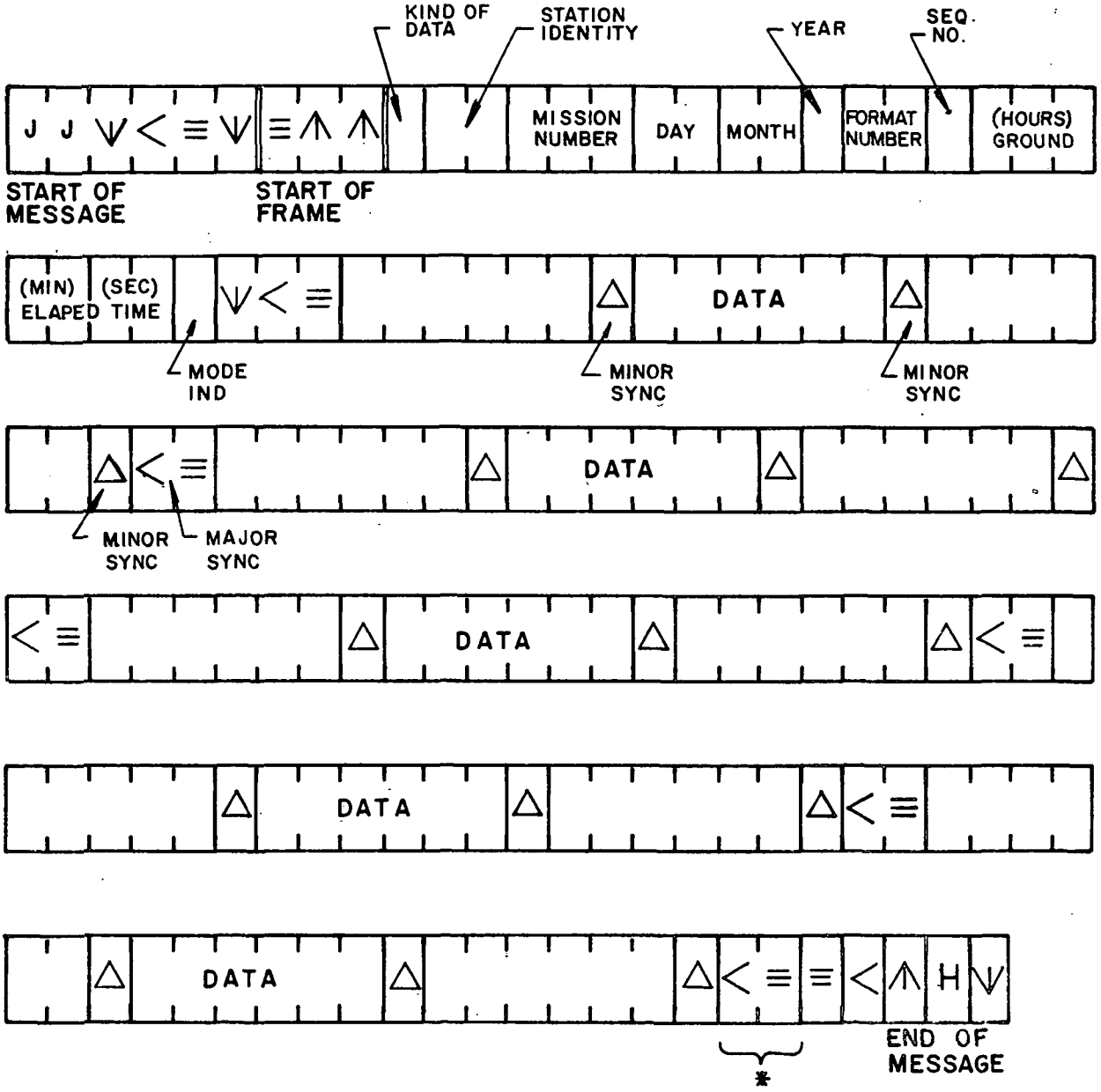
c. Mission Number. Three characters identifying flight or simulation.

d. Date. Five characters identifying day (2 characters), month (2 characters), and year (1 character) that message was generated at remote site

e. Format Number. Two characters identifying the vehicle (Gemini or Agena) and type of summary being sent (M = main summary, A = contingency format A, B = contingency format B, etc.)

f. Sequence Number. One character identifying where a given message lies in the sequence of messages from a vehicle's pass over one site and whether rebroadcast is indicated

TTY Character	Function
1	First message of this format; rebroadcast to network
2	Second message of this format; rebroadcast to originator only
3	Third message of this format; rebroadcast to originator only
5	Second message of this format; rebroadcast to network



* THESE CHARACTERS ARE INCLUDED ONLY WHEN THE "END OF MESSAGE" OCCURS AFTER A SEQUENCE OF THREE "SPACE CHARACTERS," OTHERWISE THESE CHARACTERS SHOULD NOT BE INCLUDED.

Figure 4 4-27 Telemetry Teletype Summary Message Format

TTY Character	Function
6	Third message of this format; rebroadcast to network
9	Tape playback only; rebroadcast to network

g. Ground Elapsed Time (GET). Seven characters identifying the GET in hours (3 characters), minutes (2 characters), and seconds (2 characters) when message was generated at remote site.

h. Mode Indicator. One character identifying Inertial Guidance System computer mode of operation when the format number is 40; otherwise identifying on-board dump or tape playback

TTY Character	Meaning
0	Normal summary message
1	Prelaunch mode
3	Patch-up mode
4	Rendezvous mode
5	Re-entry mode
6	Touchdown - predict mode
9	Dump/tape playback.

Following the frame description are message header/data separation characters consisting of a letter character, a carriage-return character, and a line-feed symbol.

Each telemetry parameter takes up two teletype characters with four bits to a character. The fifth bit in each character is an even parity bit on the four bits of data contained in that particular character position.

For every three parameters (six teletype characters) there appears a minor sync (teletype space symbol), and after every three groups of three parameters there appears a major sync (teletype carriage-return and line-feed symbols). This pattern continues until the end of message

occurs. If the data ends on a character other than a minor or major sync, zeros are added to the data characters up to the next sync. The end of message consists of a line feed, a carriage return, a letter symbol, an H character, and a figure symbol.

4.4.2 Grand Canary Island Tracking Station

The Grand Canary Island Tracking Station (CYI) is identical to the South Texas Tracking Station (Paragraph 4.4.1) with the exception of data output to the MSCC. CYI outputs just the telemetry teletype summary messages at 60 wpm and not the 2.0K bps data. (See Figure 4.4-24.)

4.4.3 Kauai, Hawaii Tracking Station

The Kauai, Hawaii Tracking Station (HAW) is identical to the South Texas Tracking Station (Paragraph 4.4.1) with the exception of data output to the MSCC. HAW outputs just the telemetry teletype summary messages at 100 wpm and not the 2.0K bps data. (See Figure 4.4-24.)

4.4.4 Carnarvon, Australia Tracking Station

The Carnarvon, Australia Tracking Station (CRO) is identical to the South Texas Tracking Station (Paragraph 4.4.1) with the exception of data output to the MSCC. CRO outputs just the telemetry teletype summary messages at 60 wpm and not the 2.0K bps data. (See Figure 4.4-24.)

4.4.5 Guaymas, Mexico Tracking Station

The Guaymas, Mexico Tracking Station (GYM) is identical to the South Texas Tracking Station (Paragraph 4.4.1) with the exception of data output to the MSCC. GYM outputs just the telemetry teletype summary messages at 60 wpm and not the 2.0K bps data. (See Figure 4.4-24.)

4.4.6 Rose Knot Victory (Ship No. 1) Tracking Station

The Rose Knot Victory (Ship No. 1) Tracking Station (RKV) is identical to the South Texas Tracking Station (Paragraph 4.4.1) with the

exception of data output to the MSCC. RKV outputs just the telemetry teletype summary messages at 60 wpm and not the 2.0K bps data. (See Figure 4.4-24.)

4.4.7 Coastal Sentry Quebec (Ship No. 2) Tracking Station

The Coastal Sentry Quebec (Ship No. 2) Tracking Station (CSQ) is identical to the South Texas Tracking Station (Paragraph 4.4.1) with the exception of data output to the MSCC. CSQ outputs just the telemetry teletype summary messages at 60 wpm and not the 2.0K bps data. (See Figure 4.4-24.)

SECTION 5

APOLLO FUNCTIONAL TELEMETRY FLOW

5.1 SCOPE OF SECTION

This section contains a functional description of the telemetry flow throughout the GOSS telemetry network during the portion of the Apollo project which overlaps in time with the Gemini project. The equipment configuration is essentially the same for Apollo as it is for Gemini with the exception of the DSIF added to the configuration. No detailed information exists at this time for any differences that may exist between the Gemini and Apollo GOSS telemetry network configuration. As information becomes available, it will be supplied in a later revision of this book.

5.2 INTEGRATED MISSION CONTROL CENTER

(To be supplied.)

5.3 APOLLO LAUNCH DATA SYSTEM

The Apollo Launch Data System (ALDS) is essentially the same as for the Gemini project. (See Paragraph 4.3.)

5.3.1 Cape Kennedy

Cape Kennedy performs the same function for the Apollo Earth orbit phase as it does for the Gemini program. (See Paragraph 4.3.1.) Once the Apollo spacecraft is placed on the lunar trajectory and extends beyond 4,000 miles from Earth, the unified frequency S-band telemetry equipment in the spacecraft is used, and the Deep Space Instrumentation Facilities accept the telemetry data from the spacecraft.

5.3.2 Atlantic Missile Range Sites

The Atlantic Missile Range (AMR) sites perform the same functions for the Apollo launch and Earth orbit phase as they do for the Gemini program. (See Paragraph 4.3.2.) Following the Apollo Earth orbit phase, (Apollo placed on lunar trajectory) the AMR sites are inactive until Earth re-entry of the Apollo spacecraft.

5.3.3 Bermuda Tracking Station

The Bermuda tracking station performs the same function for the Apollo launch and Earth orbit phase as it does for the Gemini program. (See Paragraph 4.3.3.) Following the Apollo Earth orbit phase, the Bermuda tracking station is inactive.

5.4 NEAR SPACE INSTRUMENTATION FACILITIES (REMOTE SITES)

The remote sites are all used during the Apollo Earth orbit phase. Following the Earth orbit phase, the remoté sites are inactive until Earth re-entry of the Apollo spacecraft.

5.4.1 South Texas Tracking Station

The South Texas tracking station performs the same function for the Apollo Earth orbit phase as it does for the Gemini program. (See Paragraph 4.4.1.) Following the Apollo Earth orbit phase, the South Texas tracking station is inactive until Earth re-entry of the Apollo spacecraft.

5.4.2 Grand Canary Island Tracking Station

The Grand Canary Island tracking station performs the same function for the Apollo Earth orbit phase as it does for the Gemini program. (See Paragraph 4.4.2.) Following the Apollo Earth orbit phase, the Grand Canary Island tracking station is inactive until Earth re-entry of the Apollo spacecraft.

5.4.3 Carnarvon, Australia Tracking Station

The Carnarvon, Australia tracking station performs the same function for the Apollo Earth orbit phase as it does for the Gemini program. (See Paragraph 4.4.3.) Following the Apollo Earth orbit phase, the Carnarvon, Australia tracking station is inactive until Earth re-entry of the Apollo spacecraft.

5.4.4 Kauai, Hawaii Tracking Station

The Kauai, Hawaii tracking station performs the same function for the Apollo Earth orbit phase as it does for the Gemini program. (See Paragraph 4.4.4.) Following the Apollo Earth orbit phases, the Kauai, Hawaii tracking station is inactive until Earth re-entry of the Apollo spacecraft.

5.4.5 Guaymas, Mexico Tracking Station

The Guaymas, Mexico tracking station performs the same function for the Apollo Earth orbit phase as it does for the Gemini program. (See Paragraph 4.4.5.) Following the Apollo Earth orbit phases, the Guaymas, Mexico tracking station is inactive until Earth re-entry of the Apollo spacecraft.

5.4.6 Rose Knot Victory (Ship No. 1) Tracking Station

The Rose Knot Victory tracking station performs the same function for the Apollo Earth orbit phase as it does for the Gemini program. (See Paragraph 4.4.6.) Following the Apollo Earth orbit phase, the Rose Knot Victory tracking station is inactive until Earth re-entry of the Apollo spacecraft.

5.4.7 Coastal Sentry Quebec (Ship No. 2) Tracking Station

The Coastal Sentry Quebec tracking station performs the same function for the Apollo Earth orbit phase as it does for the Gemini program. (See Paragraph 4.4.7.) Following the Apollo Earth orbit phase, the Coastal Sentry Quebec tracking station is inactive until Earth re-entry of the Apollo spacecraft.

5.5 DEEP SPACE INSTRUMENTATION FACILITIES (DSIF)

The DSIF consists of three tracking stations located approximately 120 degrees apart around the world. The stations are located in Southern Europe, Australia, and the United States. The DSIF are used for receiving the unified frequency S-band telemetry signals from the Apollo and the LEM spacecrafts during the lunar trip. (More detailed information concerning the DSIF will be supplied when available.)